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REPORTS FROM THE MODEL ENGINEER EXHIBITION

Model Engineer

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FEBRUARY 19th, 1971

CONTENTS

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COVER PICTURE

Thornycroft steam waggon " Dorothy " owned by Phipps Brewery Ltd., Northampton, and seen at the Stanford Hall Rally, 1966. Colour photograph by David Pinfold.

NEXT ISSUE

The LBSC Bowl Competition at the Model Engineer Exhibition: Two-stroke petrol engines.

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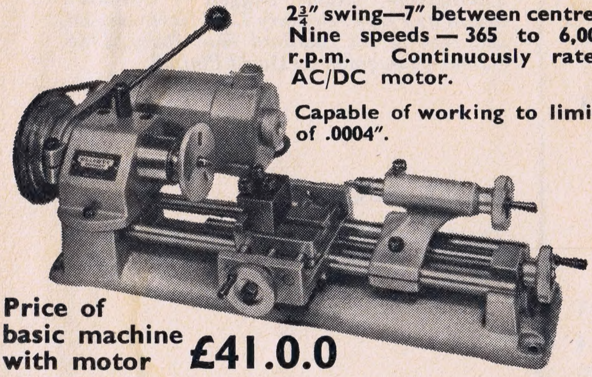

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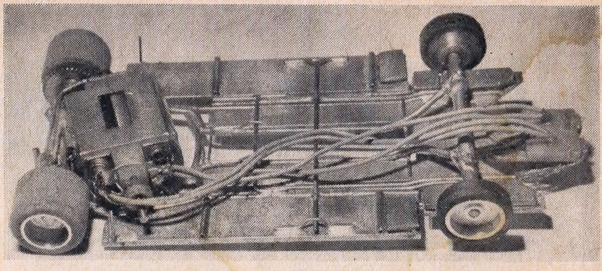

Just a few of the exciting features on schedule for the March 1971 issue of Model Cars are an intriguing model steam car—the Locomobile of 1897—and a new range of die-cast kits of hard-to-collect prototypes in 1/43rd scale. Then there's a top class chassis construction feature with plans, from North London's Ian Fisher together with M.E. Exhibition racing reports and photographs.

Add to this a feature on the construction of R/C Cars from kits—Heath, Associated, Mardave and Dynamic—and this month's scale car plans (Alfa Romeo T 33/3) from Roger Taylor and John Wood plus all the regular features—and a few still in the planning stage—and we think you'll agree that March's issue maintains a high standard already set for '71.

Model Cars

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Model Railway News

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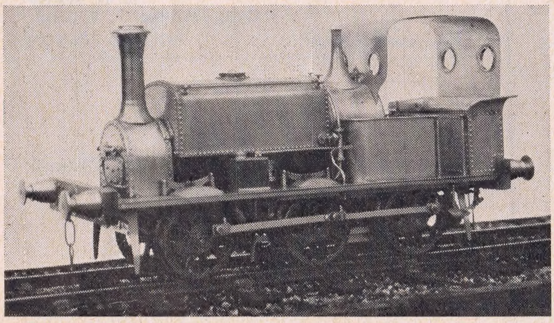

Photograph above shows D. R. Featherstone's O gauge model of a Manning Wardle 0-6-0 tank locomotive. Read a full description in this issue. In 4mm. scale, Martin Waters describes his Lancashire and Yorkshire 0-6-0's. More scale drawings from Les Darbyshire and Graham Warburton; layout construction by Noel Coates; modern rail-tank wagon described by Peter Matthews; modern branch line operation at Swanage.

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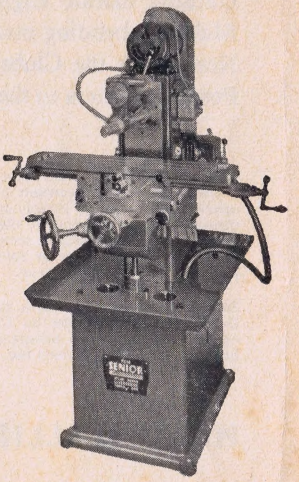

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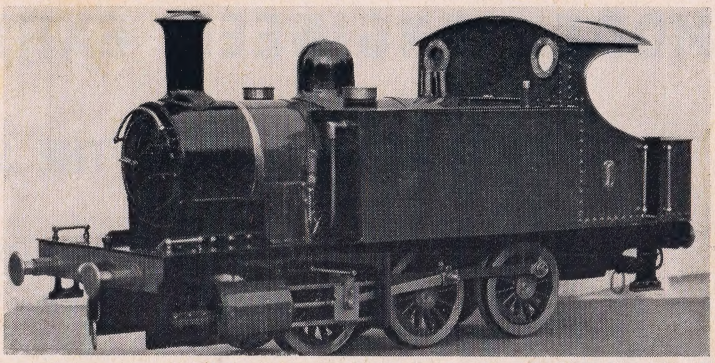
SMOKE RINGS

A Commentary by the Editor



A 3½ in. gauge tank locomotive based on the M.E. "Rob Roy" design, by A. A. Crozier of Hereford, seen at the Salop Steam Rally. Photograph by J. Bullough.

Novel competition

Visitors to the recent Model Engineer Exhibition will have had a preliminary view of the new competition organised by the Biro/Bic Company. The idea is to encourage creativity in the use of what would normally be discarded items. Eligible pens are the two types of " stick " pen, the fine-point, yellow-barrel, or the medium-point transparent-barrel. Any part of the pen may be used and any number may be built into the model.

There will be two categories: Senior and Junior, the latter for those under 16. Heat moulding will be allowed in the Senior class, but not in the Junior.

Prizes of £25, £15 and £10, plus consolation prizes, will be awarded at three-monthly intervals, and prize winners will be eligible for the National Championship, judged at the end of the year and bringing the prize money up to £250, plus a Championship Trophy. Full details of these competitions will appear in our March issues.

Isle of Man Railway

Although the number of visitors to the Isle of Man during the 1970 season was less than in 1969, the I.O.M. Victorian Steam Railway Co. still managed to increase their passenger traffic by 15 per cent, selling 50,000 tickets. The Douglas to Port Erin line was the only section being operated and this will also be the case during 1971.

Locomotives in use during 1970 were No. 4 *Loch*, No. 10 *G. H. Wood*, No. 11 *Maitland* and No. 12 *Hutchinson.* The ex-County Donegal railcars were used on four occasions for special trains. Work on rebuilding No. 13 *Kissack* with a new boiler began in September and it is hoped to have the locomotive in regular service by the beginning of next season. It is planned to re-open the line at Easter this year; regular summer services will commence on May 17 and will run until September 25 on Mondays to Saturdays. Full details can be obtained from the Manager, Douglas Station.

S.S. Great Britain

I hear that the project for restoring Brunel's famous steamship of 1843, the S.S. *Great Britain*, has received a handsome contribution from the British Steel Corporation. This consists of an outright gift of £5,000 and a further £20,000 as a ten year interest-free loan. B.S.C. regards the 128-year-old ship as a tribute to British iron.

The late Brigadier Richards

As announced in our last issue, Brigadier D'Arcy John Rigby Richards, of Cwymp Mill, Llanddulas, and more recently of Sheffield, has died, aged 80. Brig. Richards was commissioned in the Royal Artillery in 1910 and served in the Royal Artillery Garrison, Malta, until 1915, when he was transferred to the Western Front. He was promoted Captain in 1916 and Major in 1917. He was awarded the D.S.O. and the M.C. and also mentioned in despatches. He was severely wounded, the effects of which remained with him all his life.

He served with distinction in the Second World War, being appointed Brigadier to take an anti-aircraft brigade to Norway; later he took command of two A.A. brigades in the South of England. In 1943, he was in command of A.A. units covering 600 miles of the North African coast; later he helped to train American A.A. personnel, for which he was awarded the American Legion of Merit. He also took part in the Italian campaign.

On retirement in 1945, he continued his pursuit of his main hobby, model engineering, and many readers will remember his demonstrations of boiler brazing at M.E. exhibitions. After moving to Llanddulas, he took up the secretaryship of the then declining North Wales Model Engineering Society, and with P. J. Harrison, made it the thriving concern it is today.

A Society for North Devon ?

Our contributor K. E. Wilson, who has recently moved to North Devon, would like to form a Model Engineering Society in the area. Anyone interested is asked to contact Mr Wilson at Seckington Lodge, Winkleigh, Devon. Tel. Winkleigh 252.

MODEL ENGINEER EXHIBITION 1971

FURTHER REPORTS FROM THE SEYMOUR HALL

The Duke of Edinburgh Trophy

by W. J. Hughes

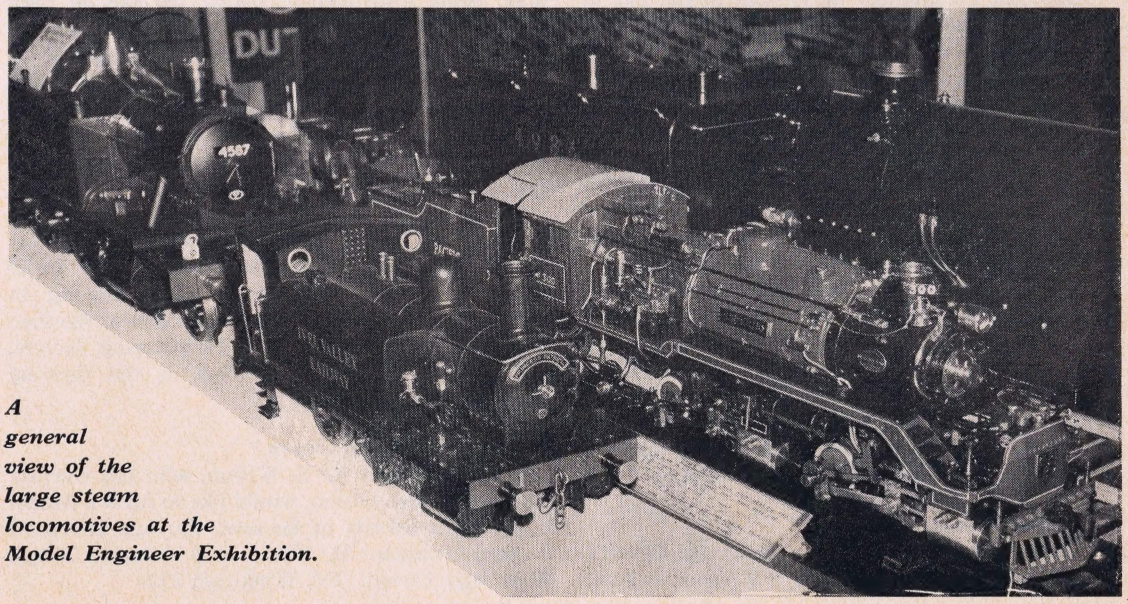
As already mentioned in my " First Impressions " article, the winner of the Duke of Edinburgh Trophy this year was Miss Cherry Hinds of Malvern with her ¾ in. scale Aveling and Porter steam roller. A good feature of this trophy is that it gives one the opportunity to see again some of the finest models in the world, and without a doubt the roller comes into that classification. One could only marvel anew at the exact fidelity of the detail, and at the superb finish—in particular, perhaps, at the so-very-fine lining-out in the livery.

Talking of detail, I think that possibly some model engineers do not realise just how much work is involved in building a traction engine or, as in this case, a road roller. The wheels of course are an obvious source of much repetitive detail, and the boiler with its hornplates and other attachments is much more complicated than most other locomotive types. The cylinders and motion, of a compound especially, have numerous extra parts, and the gearing with its differential as well as the change-speed arrangements is pretty complicated too, especially with certain prototypes.

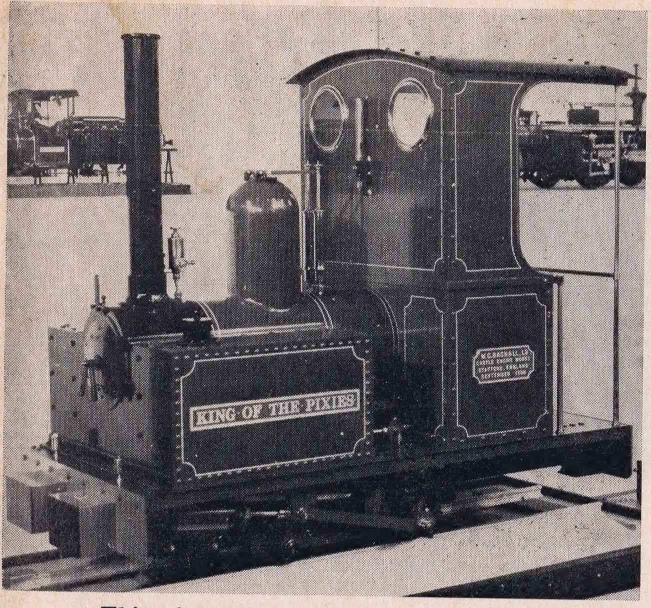
However, Miss Hinds has put everything on her Aveling—the taper-cock type blower valve, the miniature mechanical lubricator driven from the high-pressure side valve gear, the trunk-guides shaped exactly right, the strap-and-cotter big-ends, the oil-lamps, the funnel (tundish) and force-feed oilcan on the footplate, the separate balance weights bolted to the crankwebs—the lot, in fact.

A very close runner-up to Miss Hinds was the double tandem compound marine engine built by C. Cole, of Ampthill, Beds. The prototype was built by the North Eastern Marine Engineering Co. for the liner *City of New York,* and the model, at a scale of ⅜ in. to 1 ft., stood about 28 in. tall and was about 22 in. long.

Here again, the model is full of detail, and this included three " stories " of galleries and ladders,



A general view of the large steam locomotives at the Model Engineer Exhibition.

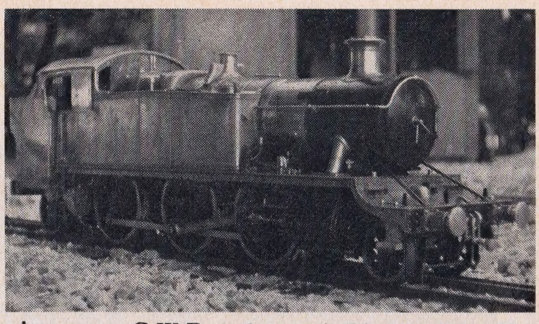


This 3 in. scale model of a Bagnall narrow gauge tank locomotive by Ann and Gordon Hatherill was awarded a Silver Medal.

the cylinders and valve chests lagged in thin strips of varnished mahogany retained by polished brass bands, a six-element thrust block with lubricators, and some exceptionally neat copper pipework. Evidently, the exhausts pass down the hollow support columns to the condensers which are built into the base castings. Four pumps are driven from each crosshead.

The valve gear is the usual Stephenson type, but it would appear that each high-pressure valve has a separate expansion valve working on its back. Certainly at the side of each pair of the Stephenson gear eccentrics is a separate eccentric, with a radial link and die from which a rod passes up parallel with and close to the normal h.p. valve rods.

Third entry in this competition was a 5 in. gauge L.M.S. Dock Shunter, Class 2F, built by B. E.



5 in. gauge G.W.R. 2-6-2 tank Class 51XX. The Championship Cup Winner by C. R. Amsbury of King's Newton: this picture was taken before the model was painted.

Cook of Hemel Hempstead, to the J. Austen Walton design. As in the other entrants, the mechanical finish and detail was excellent, but one could not help noticing, on close inspection, that there was a slight " orange-peel " effect on the black paint, and that the cream letters and figures on the sides of the tanks, " LMS " and " 11272 " were slightly streaky in places. In other words, the cream paint was not quite dense enough, and so the black tended to shade through a little.

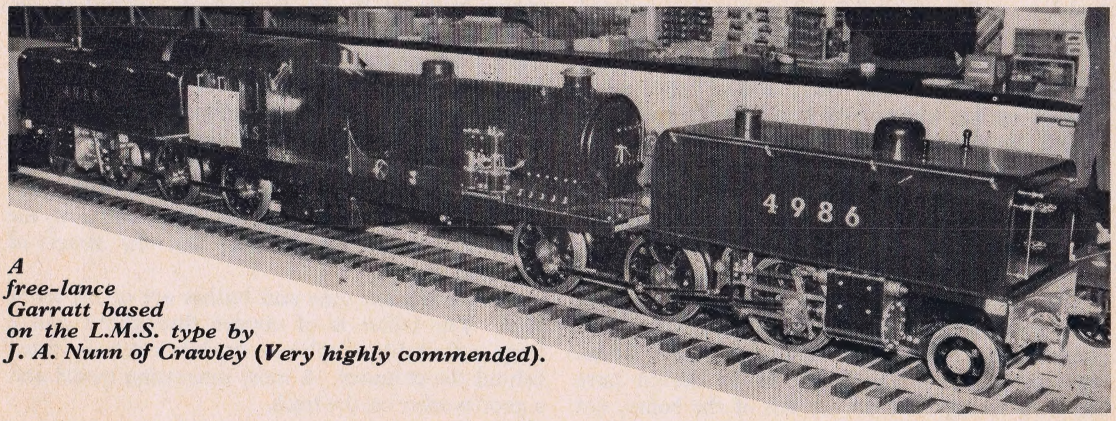
These are perhaps carping criticisms; but since marks may be lost thereby, it is not out of place to mention them, with possible benefit to future competitors.

THE LOCOMOTIVES

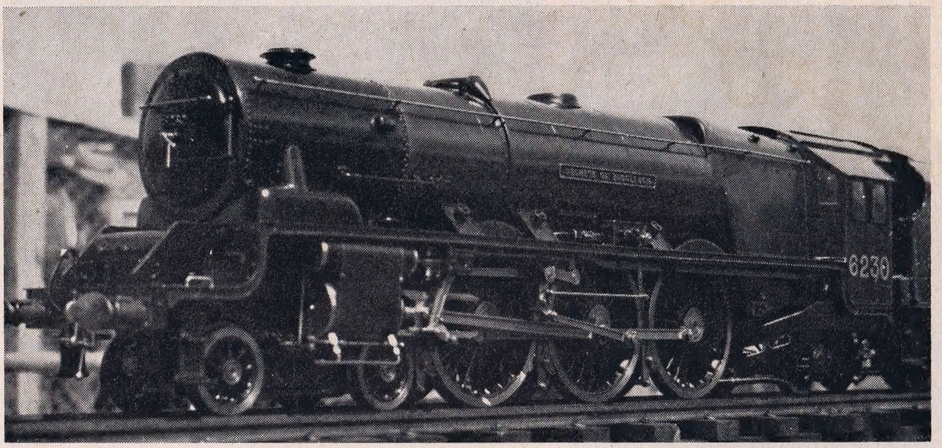
by Martin Evans

As I REMARKED in " Smoke Rings," the large scale steam locomotives at the 1971 Model Engineer Exhibition were slightly down in both quantity and quality; nevertheless, visitors were able to see some really fine engines, better than in many previous exhibitions from 1948 to 1968.

To deal with the Championship Cup winner first, this was Mr C. R. Amsbury's 5 in. gauge Great Western 2-6-2 tank, No. 5199 painted in



A free-lance Garratt based on the L.M.S. type by J. A. Nunn of Crawley (Very highly commended).



A $\frac{3}{4}$ in. scale L.M.S. " Pacific " **Duchess of Buccleuch** *by W. E. Sockett of Tipton, Staffs.: Bronze Medal.*

British Railways colours. A very fine model indeed, but if I may make a few minor constructive criticisms: The great majority of the hexagon head screws or bolts that could be seen had been left unpainted, these should be painted over according to their position on the engine. The screw couplings, presumably made for heavy hauling on the track, were on the heavy side for an exhibition model, especially the " head " of the screw itself. The crossheads too were a bit on the heavy side for a Swindon product, and I think the " slippers " were a shade too long. No whistle shield was fitted, to keep the steam out of the way of the driver's vision. The vacuum brake pipe hoses did not look altogether convincing, while the safety-valve cover was not quite straight although the shape of the boiler mountings themselves on this engine were excellent, as were the cab fittings, which included a Swindon-type lubricator.

In addition to the Championship Cup, this engine was awarded the J. N. Maskelyne Memorial Trophy.

Next in this class came another fine G.W.R. model, a small " prairie " 2-6-2 tank engine, painted in the original Great Western livery. Built by Mr W. Deane of Ongar, this locomotive was beautifully painted, the black parts being almost matt, while the riveting was some of the best I have seen.

Both the shape and the fitting of the chimney and safety valve cover were superb and would have gladdened the heart of the late " J.N.M." While the large single safety-valve may be sound practice for a working engine, this detracted somewhat from the appearance from an " aerial " viewpoint.

The valve gear rocker shaft and bearings had been faithfully copied in this model, and the number plates were beautifully produced. One small criticism—most of the boiler bands should have had their fixing bolts on the top of the boiler, not underneath the boiler barrel.

This engine was awarded a Silver Medal and the Crebbin Memorial Cup.

Another Silver Medal winner was Mr A. W. Brown of Bexhill, with a 5 in. gauge L.M.S. Fowler " 2F " 0-6-0 tank engine. This was notable for a very good plain black finish, but this, in my opinion, was rather spoilt by the letters L.M.S. and numerals 11270, which appeared to have been cut from brass sheet rather than being painted.

Here again, all hexagon screw and bolt heads and nuts had been left unpainted; I wonder why?

The side tank top plates seemed to have been sunk a little too far on this model, causing the rod stays supporting them from the boiler to be arranged at an angle; the couplings, too, were a bad shape, being very weak in the lower " U " of the hook.

But these small criticisms were outweighed by some fine valve gear, correct packing glands and excellent shape of crossheads.

Yet another Silver Medal winner was the 3 in. scale narrow-gauge 0-4-0 tank built by Ann and Gordon Hatherill. This represented a type of engine built by W. G. Bagnall of Stafford in the 1880's. Information for the project was obtained from illustrations, maker's catalogues and photographs, as no proper drawings were obtainable.

The model is intended for ground level track and has slide valve cast-iron cylinders $1\frac{1}{4}$ in. × $1\frac{7}{8}$ in. and Stephenson valve gear with proper balance weights to the weighshaft. The crossheads are properly fitted with tapered flat cotters; the eccentric sheaves are of steel and the straps of cast-iron.

All the motion pins and bushes are of hardened steel. The boiler is of copper throughout and a large adjustable displacement lubricator is fitted behind the chimney. A most interesting model and a good worker on the track.

W. E. Sockett of Tipton, Staffs., carried off a Bronze Medal for his 3½ in. gauge L.M.S. *Duchess of Buccleuch*, a very realistic effort, only marred by one or two details, such as very heavy pins in the valve gear drop link/anchor link/combination lever assembly, and the cylinder drain-cock gear splayed so far out that I am afraid it would never have cleared the platforms at the old Euston !

Four engines to be "Very Highly Commended" included a fine example of a 5 in. *Simplex* built by D. Scott-Forster of Stockport, an excellent performer this, a well-detailed 3½ in. gauge "King" by L. H. Joyce of Leyton, a free-lance Garratt by J. A. Nunn of Crawley and a 3½ in. gauge L.N.E.R. 2-6-4 tank by W. R. Skuse of Ramsgate.

Dealing with the last mentioned first, I must admit that I was rather disappointed with this engine. It was so obviously well made, but was spoilt by a most peculiar livery. The buffer beams had been painted a colour that I can only describe as a mixture of orange and red-oxide, and had yellow lining. The green body colour was not quite right for L.N.E.R. and the lining should have been black and white—not yellow. The lettering also was incorrect, as at that period, the L.N.E.R. letters were gold Gill sans with a thin black edging all around.

The edges of the front extensions of the main frames had been left bright and polished, which was unfortunate as it tended to emphasise their out-of-scale thickness. The workmanship of this engine was, however, excellent.

The free-lance Garratt was based on the L.M.S. 2-6-0 and 0-6-2 design, but what a pity to letter it "L.M.S." Mr Nunn! Surely it would be more logical to either copy the L.M.S. prototype, in which case the wheels would have been rather incongruous (they were all of the "Boxspok" type), or to letter it differently and build it as a genuine free-lance engine. The couplings on this engine, like Mr Brown's, were rather weak. They were also very highly polished and lacked any links.

Mr Joyce's Great Western "King" included some fine detail work, though the engine buffers seemed to be a little too conical at the back of the heads, and the vacuum brake pipe hoses were rather spoilt by the external wire binding, The finish too, seemed to have a rather "soiled" appearance.

An unfinished Horwich "Crab" for 2½ in. gauge was shown by Mr W. H. Balshaw, of Bolton. This included some good workmanship, but oh! that smokebox door should have "dogs" around the periphery, not the centre pin arrangement. The couplings on this engine too were rather weak.

A nicely made *Maisie* chassis by H. G. Harrison of London N.11, caught my eye. The finish and paintwork here were very good.

L. W. Tickell of Epping showed an unusual free-lance 0-4-0 + 0-4-4 Mallet, based on Canadian Pacific practice. This was for 2½ in. gauge and had cylinders 0.78 in. and 1.125 in. bore, and a boiler of a "semi-Yarrow" water tube type, with twin radiant superheaters.

The boiler was coal-fired with a drip-feed oil burner. The valve gear was slip eccentric arranged for 60% cut-off with the eccentrics placed outside the connecting rods.

Finally, there was a nice old American type 4-4-0 based on *Virginia*, by D. C. Piddington and K. A. Hughes of Birmingham (Commended), and G. Williams of Walsall carried off the New Zealand Cup with his 3½ in. gauge *Britannia.*

The small locomotives

Although there were very few entries in Class B (locomotives in gauge "I" and "O"), what they lacked in quantity they made up in quality, especially the superb narrow-gauge 2-6-2 steam locomotive by Mr R. J. K. Relph of Truro.

This engine is fitted with electric control. It is built to a scale of 16 mm. = 1 foot, and runs on 32 mm. gauge track. Two-rail current collection is used for the control motor which is 12 volts d.c.

The boiler which is spirit fired, works at 40 p.s.i., and the tractive effort is 8 oz. The electric control is sufficiently sensitive to work automatic coupling and uncoupling gear.

A mechanical lubricator is provided, driven off the rear coupled axle. The smokebox is fitted with a series of conical baffles at the base of the chimney. Thus the oil and water are separated from the exhaust steam and are collected in the bottom of the smokebox.

Full Walschaerts valve gear is fitted, with piston valves, and unlike some, the design, though free-lance, is both practical and pleasing to the eye. The engine well deserved its Silver Medal.

Two groups of Great Central locomotives made partly from plastics and cardboard were shown by A. C. Hancox of Upper Sydenham; these were most realistic, and were both Highly Commended.

D. A. Boreham, who is of course well known to readers of *Model Railway News,* showed a very interesting model, a Listowel & Ballybunion Railway double-boiler "0-3-0." This runs on a monorail, but is kept upright by two further rails arranged "flat-wise" forming the shape of a triangle.

Guide wheels on vertical pivots bear on these flat rails. Working electric headlights were fitted, but I was unable to see the "works" of this unusual engine—perhaps if Mr Boreham should read this, he will send us some explanatory notes on his engine.

THE ROAD VEHICLES

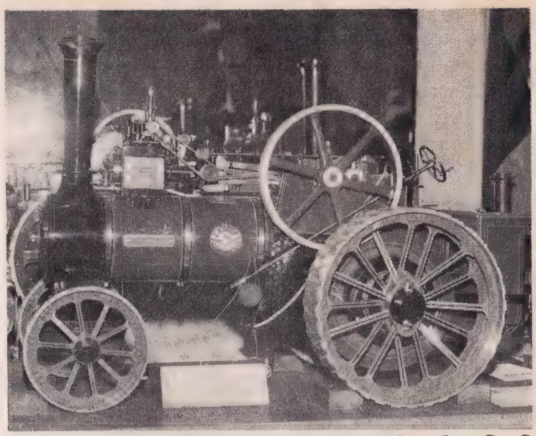
by W. J. Hughes

LAST YEAR'S winner of the Championship Cup in this class was Miss Hinds' $\frac{3}{4}$ in. scale steam roller, and this year's was four times the size—the first-class 3 in. scale Burrell traction engine by Len Crane of Wolverhampton. When I had seen this incomplete at the Dudley Exhibition in early Autumn, it was obvious it would create great interest at the London Exhibition, and so it did.

Actually, it was very difficult to fault this model: the chimney cap was not quite pure Burrell, and there was a "temporary" cadmium-plated nut on the motion which Len had meant to exchange for a steel one before bringing the engine to London. But the machinery and the paint finish were really excellent. The lining had been done by paint-wheels—these used to be advertised in these pages some years ago, but it seems they are no longer available.

The crankshaft had been turned from the solid, and then filed up to represent a "bent-from-the-bar" one. All gears, including the bevels for the compensating-gear and the governor, were cut by the builder. The boiler is of copper, with 29 tubes $\frac{1}{2}$ in. dia., instead of the 18 in. × $\frac{5}{8}$ in. called for by the published design. It certainly steams well, as I can confirm.

The details included a set of fire-irons, four double-ended spanners, a hammer and screwdriver, a working oil-can, a tea-can, a bucket correctly seamed and riveted, a long pin for locking the differential, and a set of spuds and cotters. Incidentally, it has to be reported that some unprincipled rogue stole the draught-pin from the engine's drawbar. (Fortunately, this type of offence is rare at the Exhibition!)

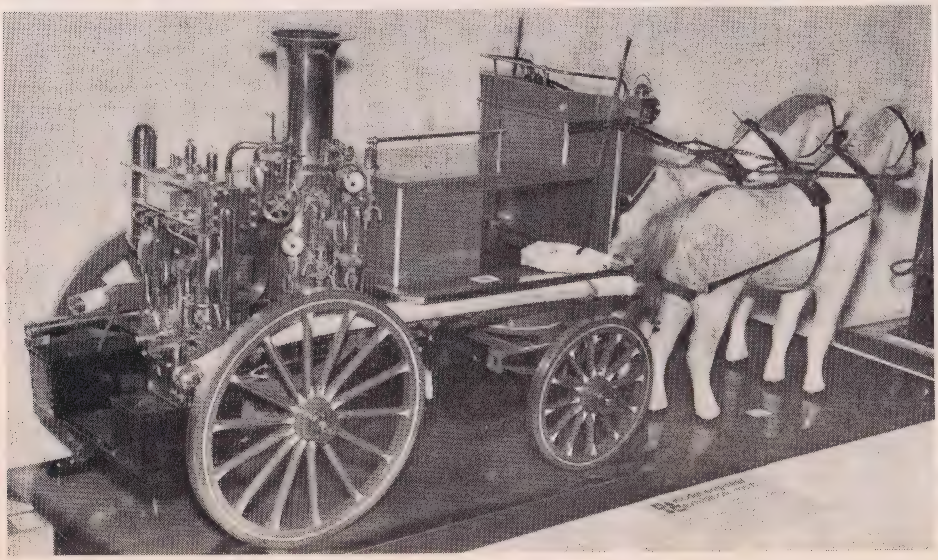


A $1\frac{1}{2}$ in. scale Allchin traction engine by S. S. Kent: Silver Medal.

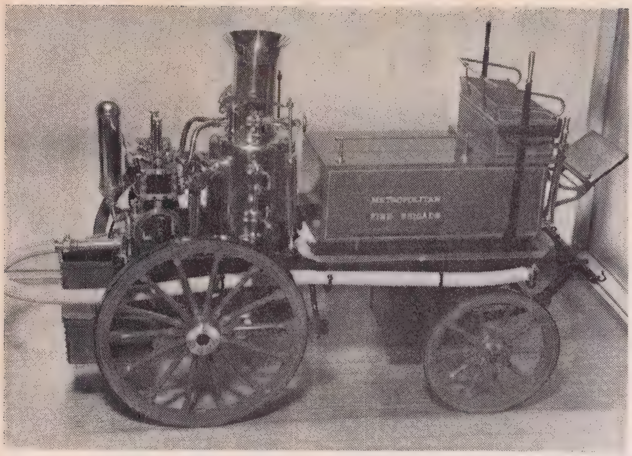
But one of the features which pleased everyone was the lighted headlamps—Len said it had taken nearly as long in experimenting to make them burn constantly as it had to make them in the first place. The rear lamp could not be lit, for where Len had been able to form the lenses of the front lamps from glass, he had had to use plastic for the red lens, which would not stand up to the heat of the flame. A suitable piece of red glass is now being sought!

The Burrell was awarded also the Aveling Barford Trophy.

Three Allchins of different scales all secured Silver Medals. The first, to the $1\frac{1}{2}$ in. scale of the published drawings, was by S. S. Kent of Sheffield, the second, to 2 in. scale, was by S. J. Crouch of



A Shand Mason horse-drawn fire engine by W. H. Heather of Midhurst. This model was awarded a Silver Medal.



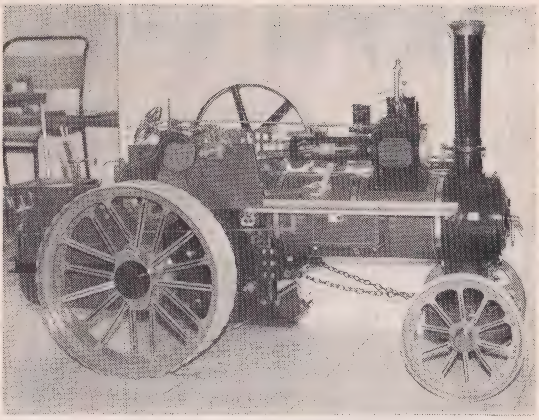
A Shand Mason horse-drawn fire engine by A. M. Tyrer of Hastings: Bronze Medal.

Sevenoaks, and the third, to 3 in. scale, was by R. L. Phillips of Dunston, Staffs.

All these had a good mechanical finish, and a standard of paintwork and lining-out which was quite good, though not in the same class as the Champion. Mr Crouch, for example, had an "orange-peel effect" on the body colour, and the lining-out was rather heavy, whilst Mr Phillips' lining tended to be somewhat uneven. However, the latter had done very well in hand-painting the two "transfers" on the boiler barrel—not the easiest of jobs as the design is rather complicated.

Mr Crouch had fabricated the "castings" for his 2 in. scale engine, and for some of the main gears had used Myford lathe change-wheels. The final drive was from a bench grinder, and the bevels for the compensating-gear were from hand-drill "rejects." My design of the bottom of the ashpan and the firegrate is hinged to allow the fire to be dropped by one lever, but Mr Crouch's omits the hinges and can be dropped right out, which is probably an improvement. The firebars are stainless steel.

A model Atkinson 8-ton steam waggon by A. Razell of London S.W.8. V.H.C.



A 3 in. scale Allchin traction engine by R. L. Phillips: Silver Medal.

On the 1½ in. scale engine, Mr Kent had the brasses for the crankshaft and second shaft in at 90 deg. to their true position—that is, long way up—and the water-hose was wrapped with copper wire. On the prototype this would be galvanised steel, which of course is not obtainable in small gauges, but tinned wire makes an acceptable substitute. On the other hand, Mr Kent had made proper fire-irons and a bucket, and had a set of lamps partly made, which he had not been able to complete in time because of illness.

A Bronze Medal was awarded to V. W. Whitbread of Stevenage, for his Metropolitan Electric Tramcar, Type H, of the 1927-8 period. This was a good model of excellent proportions, fitted out inside with seats and running on two four-wheel bogies. It was well embellished outside with advertisements typical of the period, which were neatly lettered and painted. (I wonder if the present generation knows "Walter's Palm Toffee," that succulent confection of my boyhood, which the upper panels of this tramcar advertised?)

Another Bronze Medal was won by P. A. King of Shepperton, whose Alvis "Stalwart" High Mobility Load Carrier was an excellent representation of this kind of military vehicle. Mounted on six wheels, of which the front four were steerable, the body, cab, and hull were well shaped. There was plenty of detail, and the dark green paint was well applied generally, but with traces of brush marks here and there. This is the kind of vehicle which would look well under radio control.

Finally, although it was not an exhibit, I must mention that at the Exhibition I heard of the first Allchin to my knowledge being built in *metric* sizes. It is under construction, along with three others in Imperial measure, by apprentices at the ICL Engineering Training School at Letchworth. Perhaps at a future M.E. Exhibition we may see these four engines entered for the Students' Cup?

DONCASTER "PLANT"

Some more recollections of the famous Great Northern Locomotive Works

by Don Young

THOSE NOTES on the happenings inside a steam engine cylinder came as a timely reminder that an important part of my apprenticeship—in the classroom—was in danger of being left out.

It must be admitted that at a first glance I almost ignored Thomas Hindle's opening article on condensation and leakage. That was, until the reference to Professor H. Wright Baker suddenly " jumped " out of the page. Now this worthy gentleman was an assessor of Heat Engines papers for the College. At the start of the course, our tutor referred us to " Inchley's Theory of Heat Engines," stating that if each of us did not purchase a copy, there would be little hope of passing the examination. Guess who could not afford a copy!

As the course progressed, so we became engrossed in the teachings of Professor Wright Baker. Doncaster being essentially a " steam town " at the time, us budding C.M.E.'s were exhorted to look into the possibilities of high boiler pressure, high superheat in the order of 900 deg. F. and uniflow cylinders with poppet admission valves; coupled with a taper boiler on distinctively Swindon lines. All these features were aimed at increasing the very low overall efficiency of the steam locomotive; in part by reducing the " missing quantity."

The " something like Swindon " boiler, only more so at the firebox end, was to ensure dryer steam; less water carrying over to the main steam pipe. The higher working pressure was to reduce the cylinder bore size, hence cutting down the area of cylinder wall and end covers, through which heat could escape. High superheat was to allow the steam to expand without becoming " wet," even with cut-offs as short as 5 per cent. The uniflow cylinders were to keep the temperature gradient more constant within the cylinder, so that incoming steam, through the passages, did not come into contact with metal just cooled by the departing exhaust steam. The poppet valves cut down steam leakage.

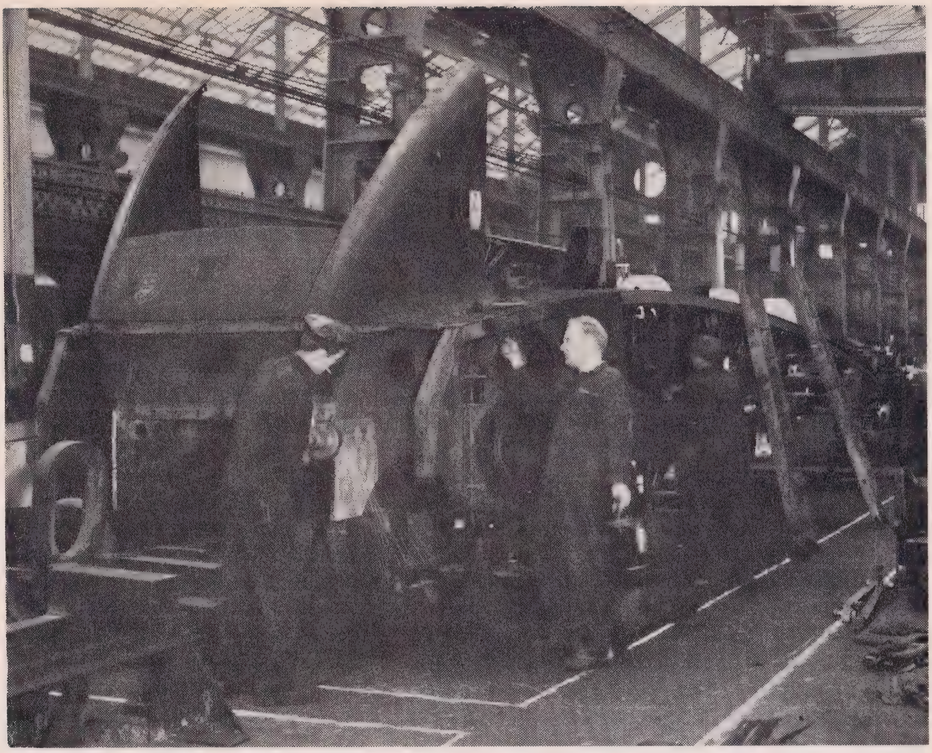
Purely on a question of thermal efficiency, all these features are worthy of adoption; yes " seekers of maximum efficiency," yours truly was (almost) converted 20 years ago. It was when one examined the physical and economic problems created that doubts crept in. For a high pressure boiler approaching a perfect form would cost at least four times a simple round backed variety, as on *Springbok*. For a working pressure in excess of 300 p.s.i., weight becomes so critical that the actual boiler size would have had to be reduced. There was never any suggestion that the conventional multi-tubular boiler be replaced, obviously the lessons learnt by Gresley with the Yarrow boiler used on No. 10,000 had stuck.

High superheat leads to metallurgical and lubrication problems, not insoluble perhaps, but again expensive. Add to this the fact that the " power pack " may travel in excess of 100 m.p.h., unlike an electricity generating station, and more difficulties arise. Many diesel engine manufacturers encountered similar problems when their early designs appeared for rail traction.

The uniflow cylinder has one big problem, the piston has to be very long, and consequently heavier than the conventional figure. This places a lower limit on piston speed, as well as placing higher loads on the bearings. As for poppet valves, the drawback was the cost of producing an infinitely variable cam, so that full advantage could be taken of the superior valve events.

These " findings " are of course personal ones, from which yours truly would probably be labelled as a pessimist. Whereas a brilliant engineer, such as O. V. S. Bulleid, would adopt the opposite tack, and go forward to design something like the " Leader " class engines. At least the original specification by our tutor, Mr Bramley, set the " grey matter " in motion, just as he intended our individual thoughts should stray. It is doubted if any of the students at the time appreciated the reason for those 20 minute " pep " talks during a lecture. The subjects discussed were far ranging, like adapting a locomotive firebox to burn sugar cane, or the possible influence of certain experiments on the underground stream that ran directly under the College Laboratories. Then the talks seemed to provide a bit of light relief, allowing us to digest the stodgier course material, like Otto and Rankine cycles. But in hindsight, the main purpose must have been to inspire individual thinking, and not merely to become indoctrinated within the confines of the syllabus. It is a pity that some of our other tutors did not adopt this technique.

Metallurgy was another absorbing subject, with a considerable practical content. Here we learnt the disturbing and dangerous embrittling features of many steels when exposed to extremes of tem-



This picture shows an excellent example of frame "patching." The fitter on the right is fitting the top slide-bar. Note the pair of bottom slide-bars in the right foreground.

perature, be it hot or cold. Likewise the deterioration of brasses. Now we could understand why smokebox securing bolts sheared, when an attempt was made to remove the nuts. Also, the reason for broken rails on a frosty morning. There was an even more striking example of this to come, for one Monday morning the 7 lb. hammer that I was wielding split completely in halves! But the feature most vividly recalled has nothing to do with railways whatsoever. This was the behaviour of Tin in very low temperatures. It directly led to the death of Scott in Antarctica. For, under these conditions, the soldered seams of the petrol cans "gave," spilling the contents.

Strength of materials, in contrast, was a rather boring subject. Yet it should not have been. The lessons absorbed however have been of great aid in my humble designs, particularly boilers. We proved theoretically, as Martin Evans has proved practically, the superiority of the monel stay. But one aspect of the syllabus has been of even greater use; design of leaf springs. The solution has been found to be of such accuracy as to predict the behaviour of our miniature springs. So the tempered spring steel, rather costly material, can be ordered with confidence. I will elaborate on this when we come to the springs on the Great Central "Atlantic."

Parts of the Theory of Machines course seemed very dated; for instance, investigation into the characteristics of the Watt and Porter governors. I doubt if any of us appreciated the important role that the epicyclic gearbox would play in rail traction, but a few years hence, as we struggled with the problems created by fixing the sun wheel. For the steam locomotive still seemed to have a bright future then, and when we came onto the problems of their internal forces and methods of mitigating their effects, these were the things that really mattered. How quickly these illusions were to be shattered.

The tutor trying to increase our electrical knowledge had a difficult task. Oh, he had a place for steam all right, in the power stations, creating his precious electrical energy. It was a pity that his predictions did not fully materialise, saving us from the "diesel age." If it wasn't for the fact that a short trip to Wath showed the beginnings of new inroads into the steam engine's territory, with the electrification of the line from thence to Manchester, I should have tended to disbelieve him altogether. For Doncaster was a long way from the Southern electrified lines. In the end, sense did prevail, and yours truly could attempt to visualise a railway without his beloved steam engines, though it was akin to a nightmare.

Theory of Structures taught the value of adequately stayed frames, I hope this shows in my

work. There was a shortage of Civil Engineers at the time, and efforts were made to convert some of the "Mechanicals." Hours spent wrestling with roof and bridge stressing problems dampened any thoughts yours truly had of a change! Fluid mechanics taught the importance of correct lubrication. There was much discussion on the possibility of replacing white-metal bearings with "plastic" ones, like P.T.F.E. Bearing lubricants cost an unreasonably high proportion of a locomotive's running costs. The idea was to replace the oil with water. But for the demise of the steam engine, I am sure there would have been some research into this subject.

Only two subjects remain, Drawing, the results of which show regularly in these pages, and Mathematics which provided excellent mental exercise, as well as helping the other subjects along.

Time spent in the classroom, and in seemingly interminable homework, was thought rather an imposition then. But later years have proved its worth. My landlady, then a sprightly 89 years old, allowed me to take over the massive dining table on Sunday mornings. As long as everything was tidy in time for the traditional Yorkshire pudding!

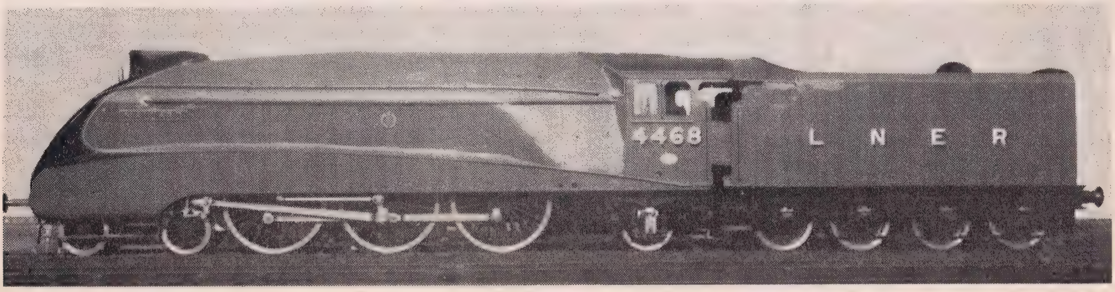
It is Monday morning again, and at 0730 hours, a rather bleary-eyed apprentice cycles hurriedly into the Plant. The next move seemed a bit of an anticlimax, to the Maintenance Shop. Here I was assigned to a "gang" consisting of Albert, Ted and Charlie, with Walt Woodeweiss as our chargehand. Each was a real character. It would be difficult to fully define the scope of the maintenance shop. Firstly, I suppose, came the Plant machinery and services. There came an introduction to huge Lancashire boilers, feed pumps, the triple piston geared type among them, and all the other paraphernalia of works steam systems. There was the hydraulic system, working at 1,500 p.s.i., with "points" all over the place. It was in this department that the art of gland packing was really mastered. For there were high speed centrifugal pumps, where overtightened or tripped glands resulted in severe heating. Again, there were the high pressure piston pumps, the glands of which also needed very special attention. Finally, there were the hydraulic accumulators, great drums filled with pig iron. The centre of the drum was a tube, which accepted a central shaft. Water was injected up the shaft, raising the cylinder up to a height of about 30 ft. The pump then cut out, until the works had used the "fluid" on such things as hydraulic riveters, to lower the cylinder sufficiently to cut the pump in again, by means of a limit switch.

On one of the accumulators, the cast-iron shaft had "bloomed," quite large barnacle like growths having formed. A famous packing manufacturer, the works of whom are alongside one of our main lines, designed a special seal, to try and overcome the irregularities of the shaft. Just for once, they had to admit to a dismal failure. The shaft had to be re-machined. Heartless as it may seem, I was pleased that the gland problem remained. For much more was learnt about using lifting tackle during the ensuing weeks than would otherwise have been possible. A "head for heights" was also acquired, which has now been completely lost. Three rungs up a ladder is about my limit these days.

One hair-raising incident stands out above all others on this job. Working on plant maintenance, discipline was a bit more relaxed; we used to "wash off" about 10 minutes before the end of the day. This gave a few minutes for chatting. Sometimes there would be some ribaldry, but more usually the discussion centred on the tasks completed and those remaining. Anyhow, there was always a mad rush for the wash bucket, for the machine minder possessed a stool sufficiently large for three bodies, and there were four of us. On this day, Albert, the senior fitter, was last. In broad Yorkshire dialect he informed us of his displeasure, leaning back against the accumulator guard rail which suddenly gave way. Albert disappeared, head first, down into the accumulator pit, some 30 ft. deep. We were horrified.

Expecting the worst, we rushed over, only to see his feet were only three or four feet from the top of the pit. Albert had become firmly wedged

Another view of "Mallard" restored to her former glory.



between the accumulator and the side of the pit. So Albert escaped with only a severe shaking. If ever a man had cause to bless his rotund form it was Albert! A few days later, the offending shaft was removed, and we were found jobs in the shop, whilst it was re-machined. It had been previously noted that two lathes in the shop had been installed in perfect alignment. Now the purpose became clear. The shaft was passed completely through the headstock of one lathe, being driven by the headstock of one lathe, with the tail end supported by the tailstock of the second. Two turners set to and quickly turned down the shaft to a very good finish. After reassembly, the accumulator functioned perfectly.

It was a good job that Albert was a good-natured soul, for I caused him further discomfort a few weeks later. We were given a weekend job to refit a triple piston geared feed pump. It was in a shocking state, valves and their seats being severely pitted. It was late on Sunday afternoon before the "boxing up" stage was reached. Yours truly was detailed off to replace the heavy cast-iron air vessel. Heavy was the right word for it, and whilst carrying it from the back of the boiler, space was a bit limited, it slipped through my hands. Nothing more was thought of this at the time, and I carried on and bolted it to the pump. The last part of the job was a trial run, and here I learnt another feature of a large Lancashire boiler. For, although the fires had been drawn some 48 hours previously, boiler pressure had only fallen to 20 p.s.i. The boiler minder had done a real good job of shutting down. There were three valves in the steam line to the pump, one of them right up in the roof. We found all three had been closed, which wasted more precious time. Albert had sat down next to the pump whilst we got steam to it. Suddenly it started, directing a thin stream of water right at his neck. The trouble was that air vessel joint. When I had let it slip, a small piece of coal was picked up on the C.A.F. packing, just big enough to prevent a water tight joint. Ted and I spent another ten minutes rectifying the fault whilst Albert dried out. The gist of the verbal tirade that was suffered was to the effect that my chances of ever becoming a Fitter were extremely remote!

Many "outside" jobs were tackled by the maintenance shop. There were all sorts of equipment used in the water softening plants, allied to the water troughs. Large gate valves to be refitted, and steam reciprocating pumps of various makes and vintage; new gear wheels for cranes, though I bet one fitter still shudders at the thought of them. A gear wheel broke on a hand crane at Sheffield, and the fitter was despatched to measure it up for a replacement. The gear train centre distance was taken, the required number of teeth to mesh calculated, a fresh wheel cast and machined. When the wheel was taken away for fitting, it was found not to mesh by one inch. The answer was soon forthcoming, the tape used by the fitter had been broken some time earlier, yes, and one inch sheared off the end. And in the rush to catch the return train that inch had been forgotten. Yours truly made the same mistake, this time of three inches, due to the same cause many years later. Although the consequences were by no means as drastic, that earlier lesson should have taught me better.

The most interesting work of all was on turntables: new ones and others returned for repair or strengthening. The fact that a 70 ft. turntable is balanced on a ball type bearing, at its centre, carrying an all-up weight of over 250 tons, has to be seen to be believed. Both ball and socket become very highly polished.

Only one, amusing, incident remains to be told. There was a highly skilled fitter and turner, Lockwood by name. Funny that for once a Christian name escapes me. Perhaps it is because a certain lady called Margaret was the screen idol at the time. Anyhow, our wages were sorted out on a early computer. One day it broke down and amidst great consternation, the maintenance department were called in, whilst the manufacturers were being consulted. The outcome was that not until a young lady mechanic arrived from Sheffield could the machine be successfully serviced. Many ribald remarks flew around a certain fitter and turner's head for the next few weeks. How times have changed!

It was time to return to the Crimpsoll, this time to look after the "details." But before doing so there is another, shadier, side of my story of time spent at Doncaster to be brought to light. I will leave readers to try and fathom out what this could be, whilst turning aside to complete the valve gear for *Elaine*.

Scanning back through these notes, I find there has been one serious omission. For I have forgotten to thank Thomas Hindle for his excellent articles, which brought those classroom memories flooding back, together with our Editor for having the courage to publish same.

"BRIDGET" A $7\frac{1}{4}$in. GAUGE 0-4-2 T

by Ken Swan

Continued from page 1233

BEHIND US in the construction of *Bridget* are many hours of toil and sweat; it can hardly be said that the details described in previous instalments have been very exciting but here is a bonus and the beginning of the more pleasurable parts of model locomotive building. When through all the work of this part, builders will surely feel that little *Bridget* is going places; she will be mobile and you will be able to try her on a $7\frac{1}{4}$ in. gauge track to see if she fits, or just push her along the floor to test the recoil of the buffers against the wall!

The axlebox guides are cut out of $\frac{5}{8}$ in. × $\frac{5}{8}$ × $\frac{1}{8}$ in. b.m.s. angle, bent over, and brazed. Before bending, it is advisable to anneal this material to reduce the possibility of cracks appearing round the bend. Just heat up to dull red, hold at this temperature for a minute or two and allow to cool slowly. After brazing, the guides should be set up on the vertical-slide and a light cut taken with an end mill over the frame and horn bolting faces to ensure squareness.

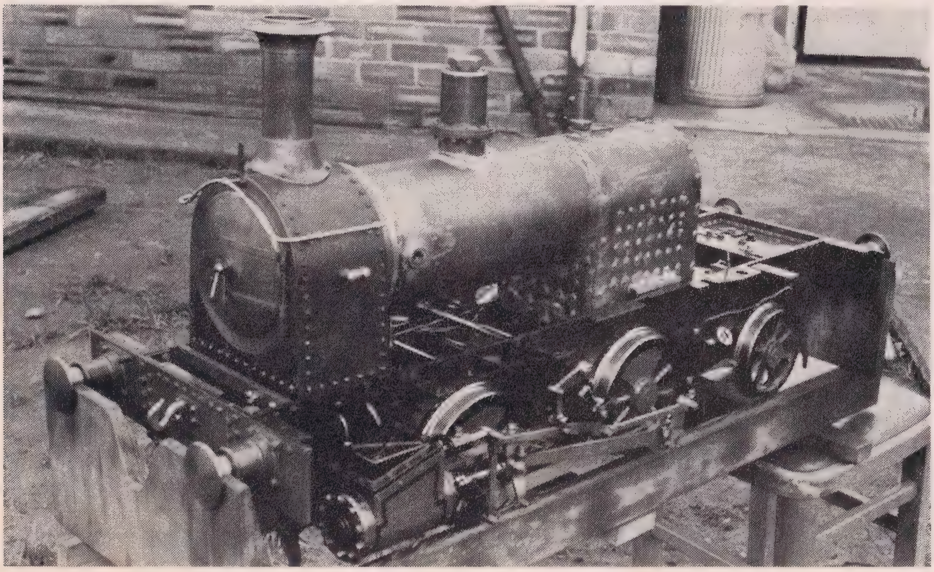
I made my horn faces from phosphor-bronze, but if I did the job again, I would seriously consider making these from gauge plate and hardening them right out. It is surprising the amount of wear that takes place on these items—no wonder the L.M.S. Railway went over to manganese steel; but I can never understand how they machined it. Fasten the hornfaces to the guides with countersunk Allen screws and self locking nuts. Avoid the temptation of using ordinary mild steel slotted screws—they are just not strong enough.

While the frames are apart for riveting on the guides, it will be worth while at this stage to rivet on the various footplate supports and boiler foot brackets, so that the frames may be permanently assembled. All these are simply short pieces of $\frac{5}{8}$ in. × $\frac{5}{8}$ in. × $\frac{1}{8}$ in. b.m.s. angle attached to the frames with $\frac{1}{8}$ in. iron rivets, with the top edge of the frame flush with the top of the angle.

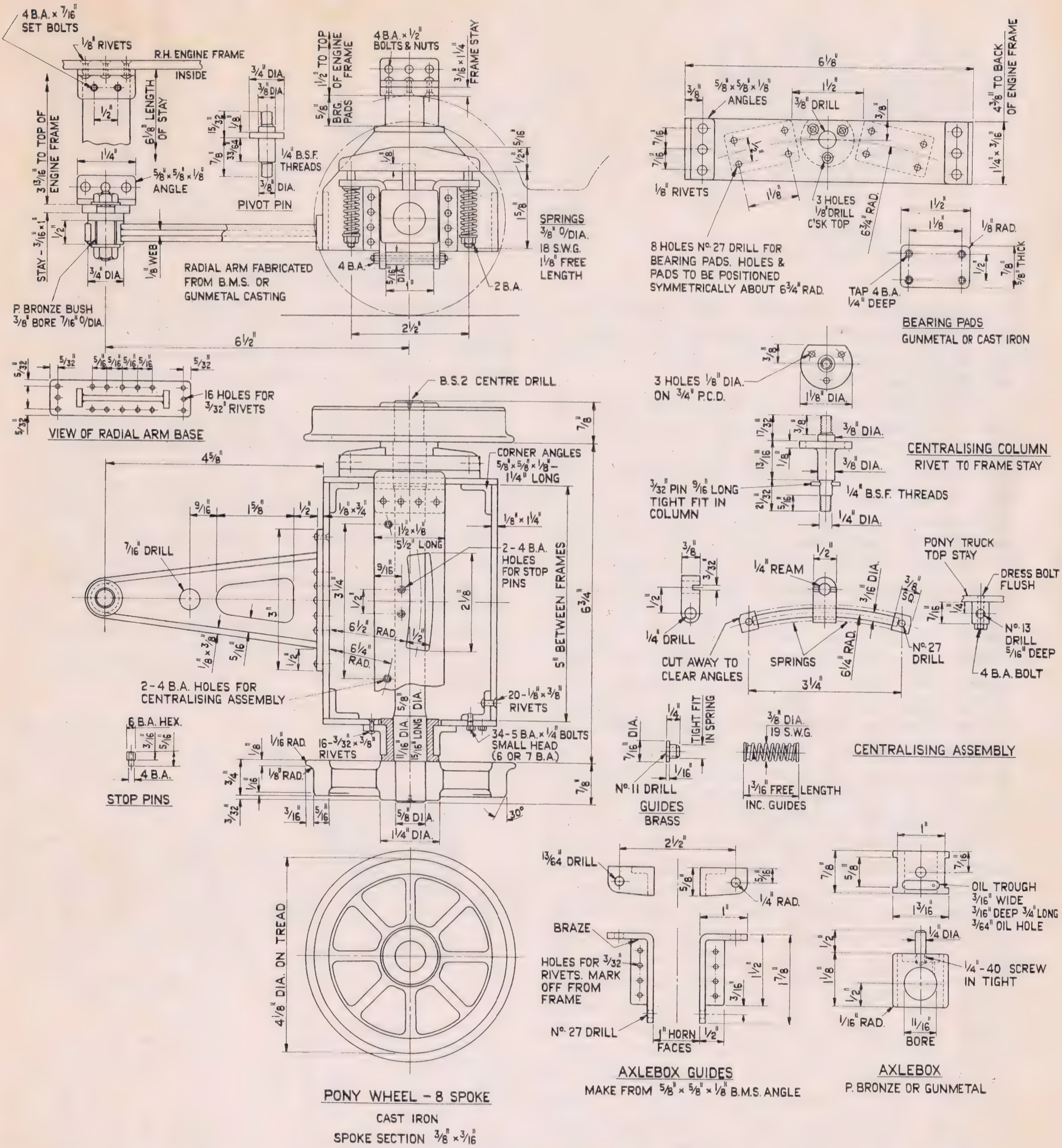
Starting from the front of the engine, the first pair of angles are 3 in. long attached to the outside face of the frame just over the third oval hole, each with six rivets. The next pair are $2\frac{1}{2}$ in. long, five rivets in each, and are for the boiler feet. These fit in the $2\frac{1}{2}$ in. long step along the top edge of the frame, the horizontal surface of the angle to project over into the inside of the frame (see cross section drawing on page 448, May 1, 1970).

Next, just $\frac{1}{16}$ in. further along, there is one angle each side $\frac{7}{8}$ in. long, attached by two rivets to the outside face. Finally to the rear of the arch for the pony wheel, a pair of angles are riveted to the *inside* face, five rivets in each.

Originally the axleboxes of *Bridget* were made from gunmetal with steel side plates and solid phosphor-bronze bushes. After seven years running, the two driving boxes were so worn both in the bores and on the sliding faces that they had to be replaced. As an experiment, these replacement



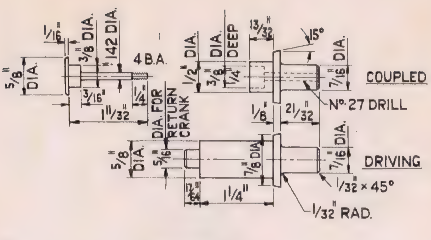
This picture of "Bridget" shows some of the footplate supports mentioned in the text.



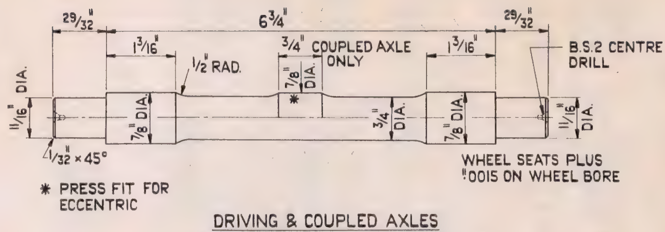
boxes were made in cast-iron; they seem all right, but it is too early to say for sure and I have not as yet examined the axle for scoring. Although phosphor-bronze is very expensive, I still think it is the best material to use; however to make replacement easier and also to give longer life, I am specifying conventional split boxes with an increased bearing diameter and length.

Start by machining each axlebox into a true rectangular block, leaving a little extra on the $1\frac{1}{8}$ in. width. Then mark off and mill out the bottom to take the keep. The keeps do no actual work as a bearing, so they can be made from common brass. They should be a snug fit in the axleboxes with well fitting pins.

With the keep in situ, carefully mark off the axle



CRANKPINS
MEDIUM CARBON STEEL 2 OFF EACH



DRIVING & COUPLED AXLES
MEDIUM CARBON STEEL 1 OFF EACH

centre and scribe a large circle. Set up in the four-jaw chuck with this circle running true, face off and drill and bore to ⅞ in. dia. Reverse in chuck and finish face to width.

To mill the grooves to fit the horns, great care has to be taken to ensure that the axle hole is central with these faces. I usually do this by having the axlebox secured on a close fitting spigot bolted to an angle plate on the vertical-slide. To keep the side of the axlebox parallel to the table of the vertical-slide, feeler gauges can be inserted between the axlebox and the table (or angle plate). It is of course taken for granted that the vertical-slide was previously set at right-angles to the lathe spindle. A cut can now be taken, the axlebox swivelled through 180 deg. and another cut taken across at the same setting. The distance over these milled faces can be checked with a micrometer and the amount of the next cuts determined and the process repeated. This is not a speedy way of doing the job but at least it achieves the required accuracy. It is wise to leave .002 in. or so to scrape off when individually fitting to the horns.

Due to the sand casting process using top and bottom moulding boxes with a parting line between, wheel castings are seldom found where the front is concentric with the back. For this reason I always play for safety and machine the front of my wheels first. Grip in the four-jaw chuck and with the aid of a surface gauge set the inside edge of the rim to run true. This is not easy as this edge is not always well defined, so before proceeding, run the lathe about 200 r.p.m. to see how the wheel looks.

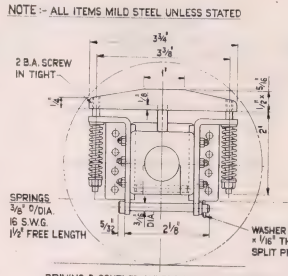
Rough and finish machine the face of the rim and boss, also take one rough cut about ⅜ in. along the tread. The hole can now be drilled and bored out about 1/32 in. undersize. The wheel should next be reversed in the chuck and the bored hole set to run true, after which the back face of the boss and rim can be machined and the hole brought to within .005 in. of finished size and reamed.

To finish turn the treads and flange, mount the wheels on a screwed adaptor held in the four-jaw chuck. It is well worth having the end of this adaptor centred so that the tailstock can be used for additional support to minimise any chatter when forming the radius at the root of the flange. Machine the tread until it cleans up all round, it does not matter if it works out a trifle less than 5 in. dia.

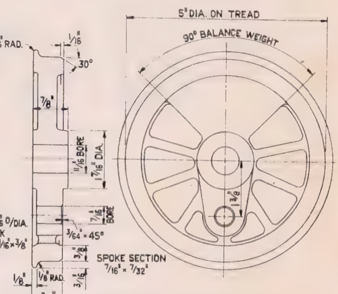
As promised, with this instalment is included the drawing showing the modifications required to suit the 7½ in. gauge. This shows the back bosses of the wheels projecting ⅛ in. out from the rim. This can just be managed with the pony wheel casting by machining the minimum amount of metal from the front face; but the driving wheels will require a washer to be added with countersink screws to form the full depth of the boss.

Many times the trouble of an engine not running freely is blamed on the wheels not being quartered correctly, when in fact it is the crankpin throws

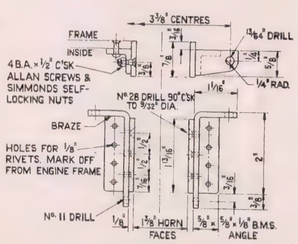
NOTE:- ALL ITEMS MILD STEEL UNLESS STATED



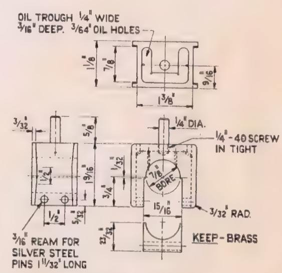
DRIVING & COUPLED AXLEBOX & GUIDE ASSEMBLY



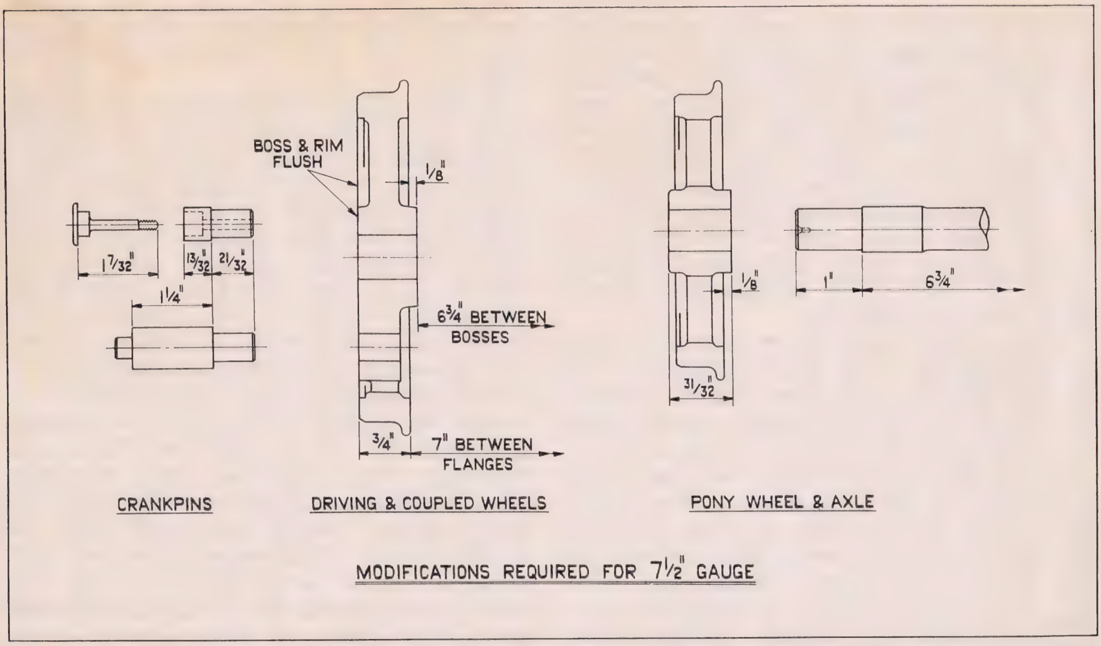
DRIVING & COUPLED WHEEL
CAST IRON 4 OFF



AXLEBOX GUIDES 4 PAIRS OFF
MAKE HORN FACES FROM P. BRONZE OR MEDIUM CARBON STEEL



AXLEBOX
P. BRONZE OR GUNMETAL 4 OFF



that are not alike or are not parallel with the axle centres. The simple jig often used for this drilling operation cannot cater for a drill wandering off, if a blowhole or hard spot in the casting is encountered.

For guaranteed accuracy of the crankpin holes, set the wheel on the lathe faceplate, locating by a $\frac{11}{16}$ in. dia. button bolted independently to the faceplate $1\frac{3}{8}$ in. off centre. The wheel can then be rotated on this button until a line drawn through the centre of the bosses lines up with the tailstock centre. Clamp the wheel in this position with a couple of bolts between the spokes; each wheel can then be centred, drilled $\frac{13}{32}$ in. and bored to within a few thou of $\frac{7}{16}$ in. and reamed.

The cranks are spaced at 90 deg., the right-hand side to lead.

The axles and crankpins are worth machining from something better than mild steel. Silver steel is a first-class hard wearing material even in its unhardened condition, but it does tend to be rather expensive in the sizes required for the axles. I find

A happy scene on the Derwent Valley Railway. The author drives his second locomotive "Shelagh" at the annual Garden Fête, June 1970.

old car half-shafts a very superior material, and of course, very cheap. Mention what you are after to your local garage mechanic; if he hasn't any old ones lying about, he will probably save some for you. On a medium-sized car, these shafts seem to be about 1 in. dia., usually with a flange at one end and a spline at the other. More often than not it is this spline that fails, leaving the remainder of the shaft quite intact. You will need a H.S.S. hacksaw blade to cut the shaft into the lengths required, sawing at a slow speed to avoid " knocking up " the edge of the teeth.

So long as you are not in too much of a hurry, you will find this material nice to machine and not at all difficult to get a beautiful finish. Remember it is just as important to get a smooth finish on the wheel seats as it is for the bearing surfaces.

Pressing the wheels onto the axles does appear to be quite a problem, especially in these larger gauges. Vices that will open to 10 in. or thereabouts do not seem to exist—certainly not in model engineers' workshops anyway. I was quite brutal with my *Bridget*, all I used to fit the wheels was a 4 lb. coal hammer with a couple of pieces of brass to protect the axle ends. I have since been educated and now find a motor vehicle screw jack is a useful tool to have around. It is surprising how many places one can find where an axle and pair of wheels can be sandwiched between the jack and some immovable object. I had better not say too much about this—ever tried lifting a three bedroomed semi?

By sheer necessity the pony truck is a very sturdy design, it has the important role of supporting approximately one quarter of *Bridget's* weight, as well as to provide steady riding qualities. Quite often I have seen model locomotives so artificially weighted to get more adhesion to the driving wheels that the bogies and pony trucks have become no more than ornaments. I remember one chap boasting about this and proved his 4-4-0 tender locomotive could run as an 0-4-0. A short while afterwards I heard that this engine came off the track injuring her owner in the process.

After the coupled wheels, axles and axleboxes, the manufacture of the pony truck becomes an interesting bit of repetition. The centralising assembly dimensions are not so critical as the sizes seem to imply. The sole requirement of this unit is to freely allow side movement of the pony truck, restrained only by the centralising springs. Note that the stay carrying the pivot pin has its angles riveted to the frames and the stay screwed to these angles, this is for good accessibility.

Next time, it will be the cylinders and their relevant details; definitely some hard times are ahead for your lathe so have it adjusted to peak condition in readiness.

BUILDING A CLASS " A8 "

by Max Lewitt

In Model Engineer, July 18, 1969, there was shown the proposed cylinder arrangement for a L.N.E.R. Class " A8 " locomotive for $3\frac{1}{2}$ in. gauge and the accompanying photographs show the progress that has been made in the construction of this engine. It represents about 18 months work averaging six hours per week.

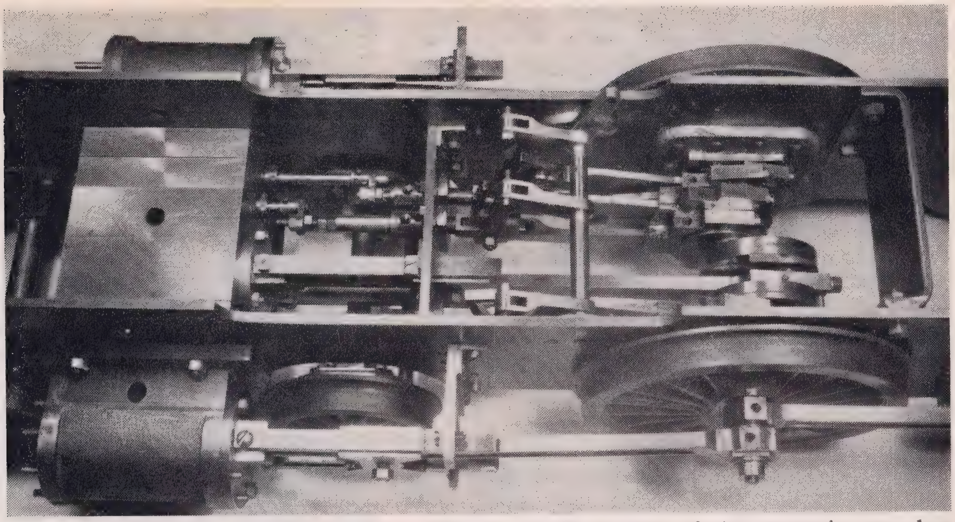
The production and assembly all went as planned and the chassis photographs were taken at the end of the first complete erection of the motion work and cylinders. The only departure from the original drawing was in the method of attachment of the valve spindles to the slide valves. The valves were only $\frac{13}{32}$ in. deep and this precluded the use of the usual piece of tapped square bar and slots in the back of the valve. The alternative valve buckle arrangement was all right in principle, but it was doubtful if perfect alignment could have been achieved for the two spindles which are fitted to the ends of the buckle.

The accompanying drawing shows the system used; this is not original, but has never been seen applied to small sizes. It has the advantage that the valve cavity can be drilled through and filed to size quicker than milling a blind cavity and the bush is then brazed in at the same time as the back is fitted. The top part of the valve body was cut back to keep the overall length over the spindle nuts to the same length as the active face section. In this locomotive valve positioning is done outside the steamchests where the valve spindles connect with intermediate rods, so that the valve itself could be set between locked collars on the valve spindle.

Having now constructed Allan, Joy, Walschaerts and Stephenson valve gear, it is the writer's opinion that the work content is far greater for Stephenson gear than for the others mentioned. In the present case the third cylinder added a further 50 per cent to the labour content. Briefly there is a lot to be said for the simplicity of Joy's valve gear, but unfortunately, with the exception of some of Mr Webb's arrangements on the L.N.W.R. compounds, this is limited to inside cylinders.

Valve setting is now in progress prior to the final cylinder assembly and a steam test from a donkey boiler.

The frequent inverting of the chassis necessary during attention to the eccentric sheave grub-screws during valve setting has justified the making of a supporting jig. It was of simple construction and

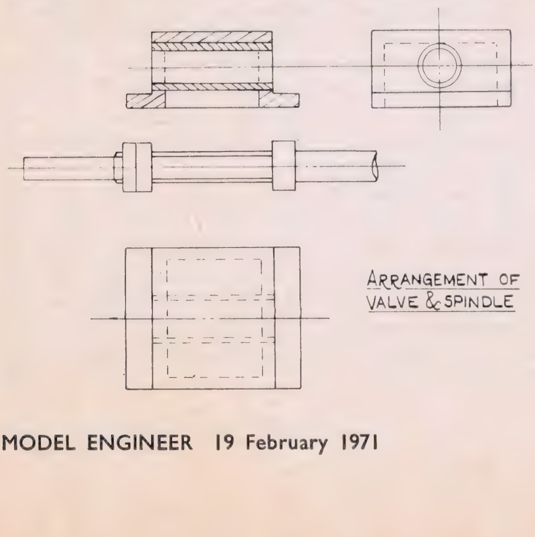


Elevation view of cylinders and motion.

consisted of two end vertical plates of 10 s.w.g. mild steel fitted to each end of a wooden baseplate. Holes in the plates took bolts also fitted through the buffer beam drawhook holes and the whole assembly was quite well balanced and proved very convenient.

I have always preferred to set slide valves by eye rather than by air pressure and to allow observation of the port faces of the outside cylinders, the inside cylinder and valve chest had to be removed temporarily. Later, to permit valve setting on the inside cylinder, the right-hand outside cylinder and chest had to be removed. However the arrangement of the intermediate valve spindles allowed the removal of any cylinder and valve chest without affecting the valve settings.

Valve setting is being done as per standard procedure in that the valves are positioned on their spindles to give equal steam port opening with full gear reverser setting and full port opening is being obtained. Valve timing is done by the angular setting of the forward and rear eccentrics in the usual way. It is a somewhat lengthy and ponderous process as the rear half of the eccentric strap has to be taken down to give access to the grub-screws each time an adjustment is required.



ARRANGEMENT OF VALVE & SPINDLE

Considerable increase in valve lead is being observed when linking up, there being over a third of the port open to steam in midgear. Although the locomotive is a North-Eastern type, a touch of Swindon is being tried with some negative lead in full gear. Naturally it is not possible to check readily at the dead centres by how much the valve is not open, but a line and line setting is being made with the reverser moved $\frac{1}{8}$ in. away from full-gear and it is estimated that the average cut-off at this point is of the order of 70 per cent. The wheels have advanced about 5 deg. past the dead centres before the valve opens. This initial setting is in the way of an experiment as it is felt that more lead will be permissible based on settings obtaining on the writer's other locomotives.

It is interesting to note instructions on valve setting in the M.E. for Stephenson valve gear and the validity or usefulness of those published is seriously questioned.

For instance, LBSC gave the usual drill of initially making equal port openings by adjusting the valve on the valve spindle; line on line timing is given for full gear on the front port for the front dead centre with the comment that if the rear port doesn't open as much at the rear dead centre, then, the valve is too long.

This is simply not true, as with this procedure the rear port timing will be identical with the front port setting, irrespective of the valve length, within the limits achievable for the particular valve gear configuration being used. This has been demonstrated on the valve gear model illustrated in the earlier article referred to above.

Errors in the valve length should be obvious at

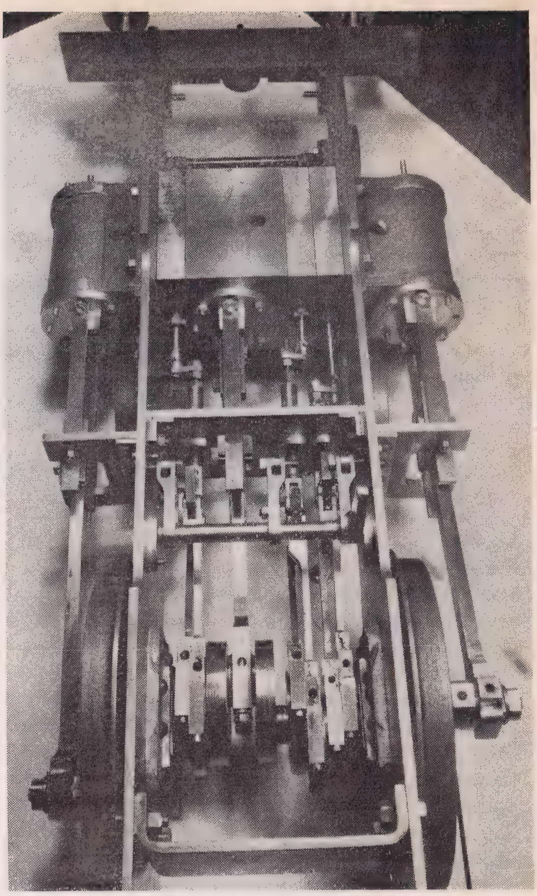
the "valve position on the spindle" setting stage, when adequate port opening may not be achieved if the valve is too long. The word adequate is used deliberately as in the case of LBSC, full port opening for steam admission was not always his policy. If full port opening is required and not being achieved, some calculation checks may be necessary as the valve may be the correct length and the restricted port opening due to insufficient eccentric throw. In such a case if the throw is not too short then the valve could have the laps reduced (to avoid pulling wheels off to replace eccentrics) to give the original full gear cut-off, but it could be that the original required port opening would not be possible.

Valve setting

Mr Don Young in his instructions for valve setting on *County Carlow* is not too explicit and simply advises equalisation of the front and rear lead quantities even if this involves altering the initial setting of the valve for equal port openings and doesn't mention other possible arrangements.

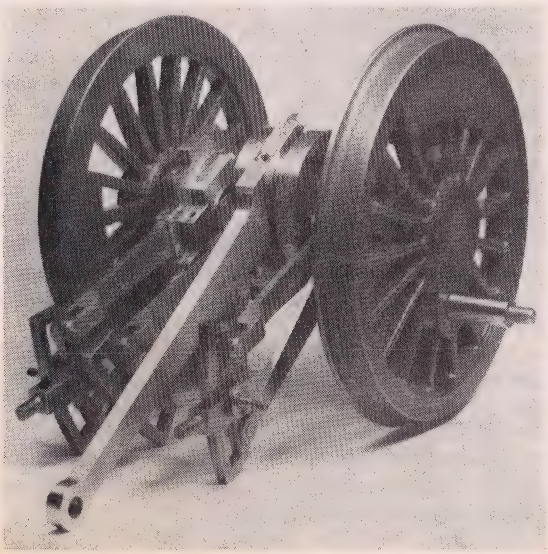
It must be borne in mind that the inherent lack of symmetry in the events of any valve gear will introduce inequality in the timing of events and will upset the balance of leads, cut off and port openings.

With the present "A8" locomotive where the valve gear proportions and layouts are very similar to *County Carlow*, it was found that at the settings being obtained with the $\frac{1}{8}$ in. displacement of the reverser from full forward gear that the leads were balanced, as were the port openings. However, the maximum port openings do occur at different points in the stroke and the cut-off points are consistently shorter for the rear events. The short connecting rod is a contributing factor to this latter effect.



Plan view of chassis.

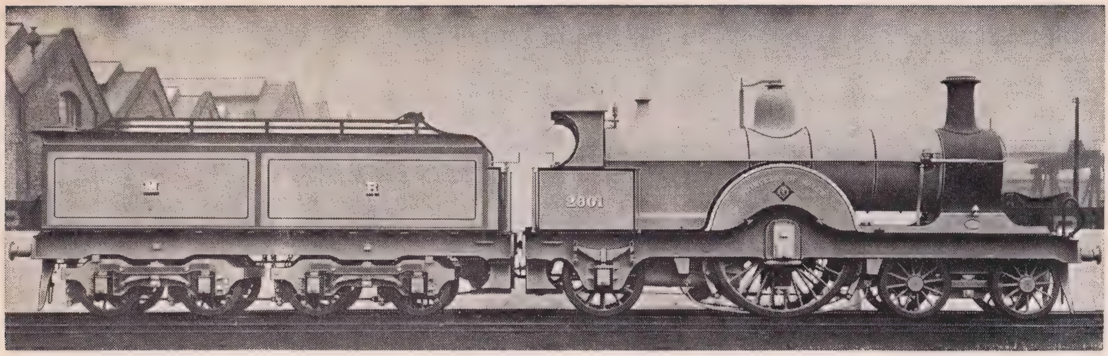
View of driving wheels and axle.



Full-size settings

This, of course, is also characteristic of full-size and it is understood that settings were made for equal lead or equal cut-off depending on the duty intended for the locomotive in question. It could be that even in our smaller versions, similar considerations may permit better performance depending on the use intended.

It was noticed in Mr Young's articles that he used a link with a radius larger by $\frac{5}{32}$ in. than the dimension to the link centre line at the eccentric rod connecting points. It is assumed that this was to reduce the increase in lead when linking up and it would be interesting to know if this was so and how Mr Young derived the amount to increase the link radius. ■



PRINCESS OF WALES

5 in. gauge Midland "Single," described by Martin Evans

Part 14

Continued from page 136

HERE WE ARE with the boiler for our *Princess*, and if this doesn't make all the steam the engine can use, given reasonable workmanship of course, well I'll give up designing locomotives for good!

This boiler follows the very simple design evolved for my 5 in. gauge free-lance 0-6-0 tank *Simplex*, but it incorporates one or two very useful improvements which have occurred to me since the *Simplex* boiler was built, also a most helpful suggestion from K. N. Harris, regarding the problem of extending the outer firebox wrapper. As can be seen from the drawings, the outer firebox wrapper is cut and bent out of the same tube as is used for the barrel, but instead of making two longitudinal cuts at an equal distance from the bottom centre-line, as is the usual practice, only one cut is made—well to one side as seen in the end elevation—and after opening out, it will be found that on one side, the wrapper is of the full depth required. Thus we only need to extend the wrapper on one side of the boiler only, a great labour saver.

From experience with my original boilers, I came to the conclusion that with the rather small barrel diameter of the "Single" boiler, it would be possible to dispense with the two "plate" stays, made from flat sheet copper, which in the *Boxhill* boiler were brazed on the inside of the backhead and smokebox tubeplate before these were assembled. This has been made possible by brazing rather hefty gunmetal bushes to the appropriate plates, so that the unsupported flat areas of the backhead and smokebox tubeplate are kept to the minimum. Thus we have now got rid of all longitudinal staying, apart from the blower stay, but this really only acts as a blower tube, its strength in tension can be ignored in this boiler.

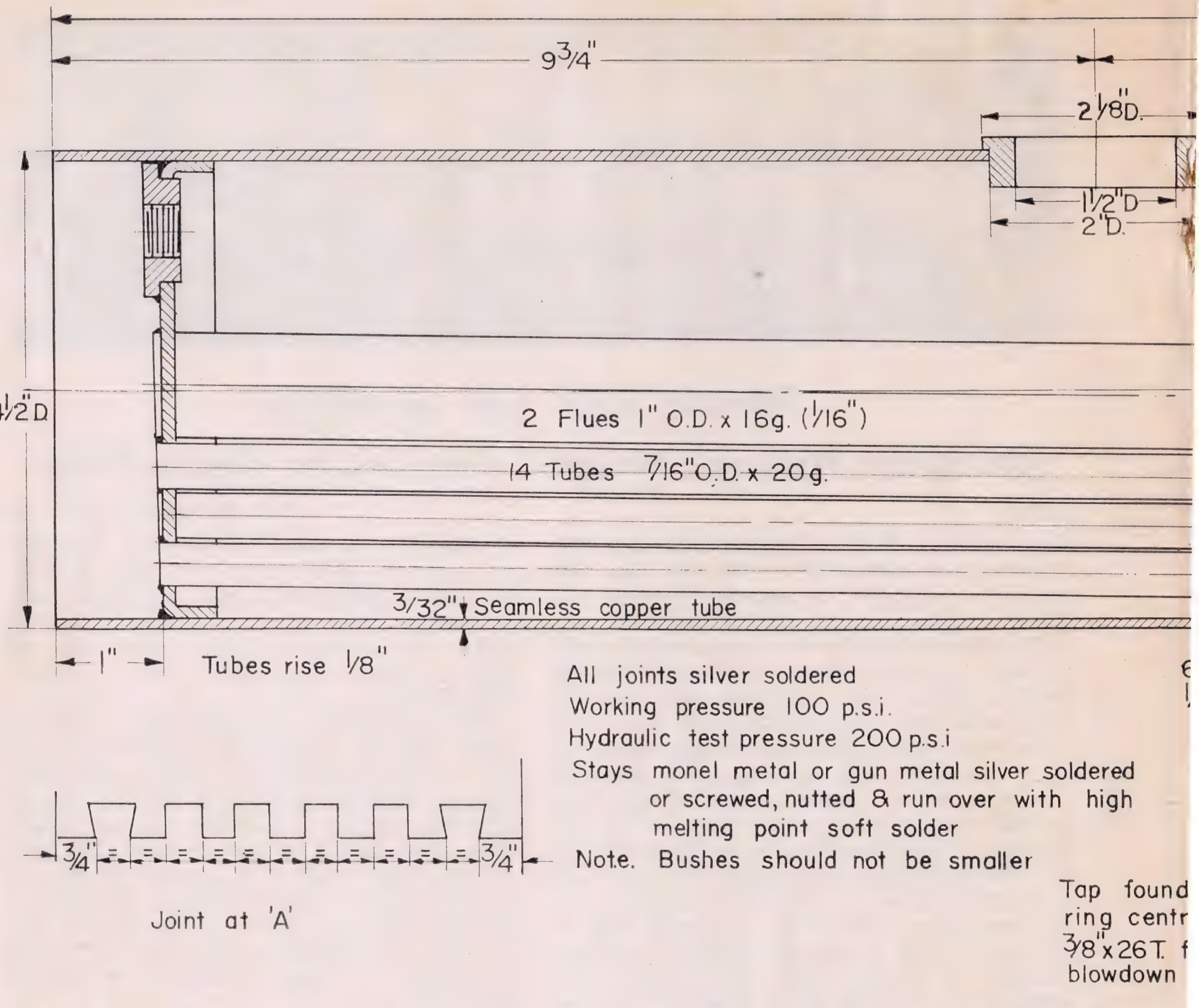
As will be seen, the "improved Simplex" type of crown stays are used, and although these may look somewhat elaborate at first sight, they are only built up from odd pieces of $\frac{1}{8}$ in. copper sheet, and will be found very easy to fit and to silver solder—use just enough $\frac{1}{16}$ in. copper snaphead rivets to hold all the parts in place, then silver solder the lot.

Perhaps I should once again warn prospective builders that the firebox stays in this boiler must not be made of copper; they should be made from drawn gunmetal, though for those fortunate enough to be able to obtain it, Monel metal would be even better. Although all the stays in the whole boiler are better silver soldered, if anyone has difficulty over this, the stays may be threaded (40t) through both plates, nutted as shown on the fire side, then run over with high-melting-point soft solder. *On no account* use ordinary plumber's or tinman's soft solder.

Builders will note the large water space at the throatplate (Vide K.N.!) so that water circulation should be good. Another point is that in spite of the smaller barrel (than *Simplex*), I have been able to get in one more superheater flue and one more $\frac{7}{16}$ in. tube, without overcrowding the tubeplate.

To make for easy firing on the run, the firehole is larger than ever, the thick-walled tube used being 2 in. o.d. This also helps the problem of staying the backhead. The superheater may be of the firebox radiant type, the two pairs of $\frac{3}{8}$ in. stainless steel elements being bent slightly upwards at the extreme rear end, so as not to get in the way of the firing shovel.

Another unusual feature is the position for the blowdown valve. I found that it was impossible to arrange for the usual blowdown valve on each side of the firebox, operated by wheel or key from



All joints silver soldered
Working pressure 100 p.s.i.
Hydraulic test pressure 200 p.s.i
Stays monel metal or gun metal silver soldered or screwed, nutted & run over with high melting point soft solder
Note. Bushes should not be smaller

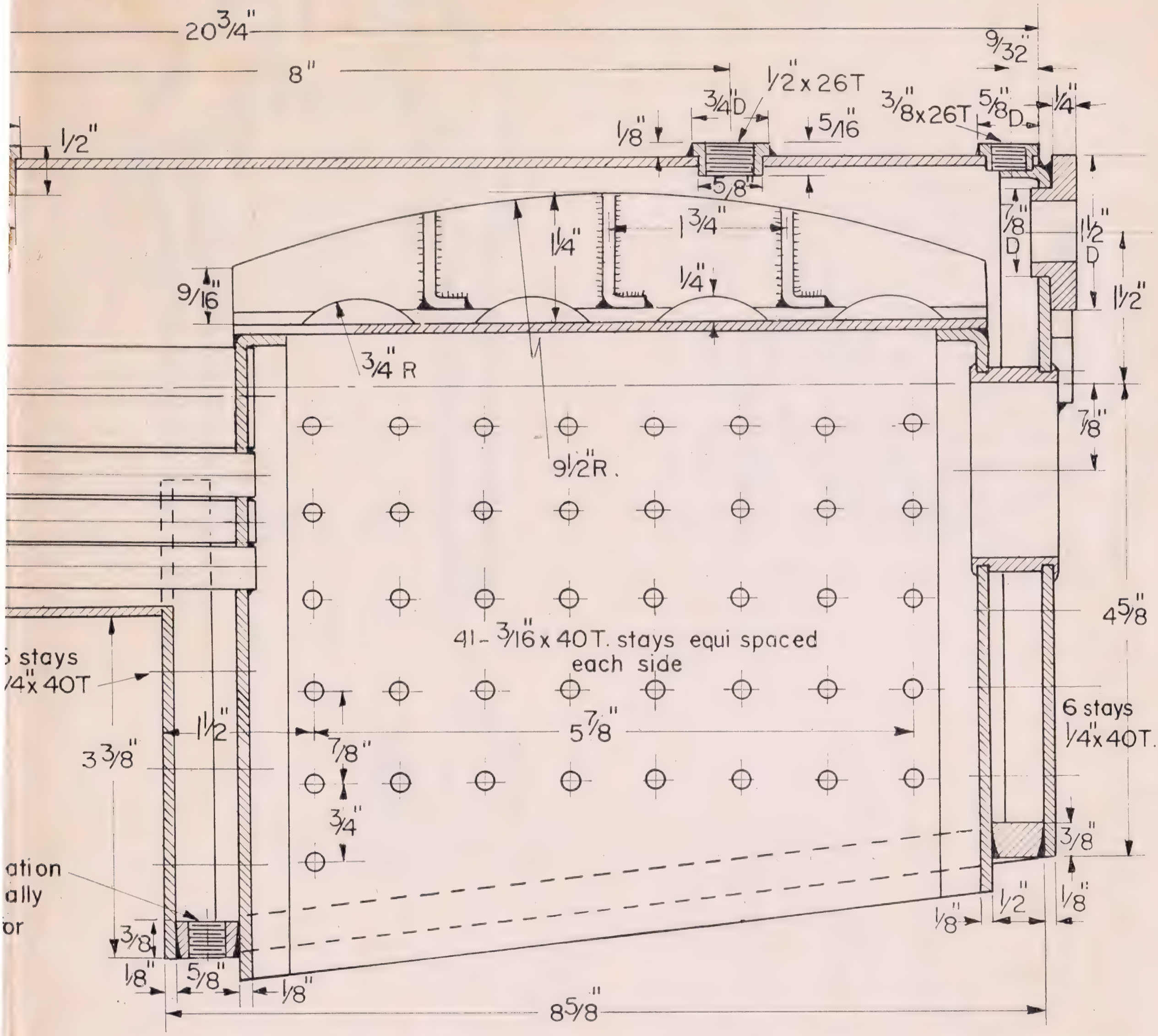
the side of the locomotive, owing to the outside frames getting in the way. But there is nothing immediately below the front water leg of the firebox, so the obvious thing to do was to drill and tap the foundation ring itself, and fit the valve centrally; but it will have to be so designed that it does not foul the front edge of the ashpan.

As far as boiler feed is concerned, I would suggest two injectors plus the usual emergency hand pump in the tender; but there is no need for three boiler check or clack valves. Two are fitted to the backhead, as on the full-size job, the feed from the hand pump being connected to one of the delivery pipes from the injectors.

Readers may query the rather heavy foundation ring this time, as I normally specify rectangular copper bar for this, $\frac{1}{4}$ in. thick. But we badly need all the adhesion weight we can get, especially behind the driving wheels, and a little extra weight here will help things along in this connection.

Before talking about the actual construction, may I say a few words about brazing equipment and silver solders? Even now, I receive quite a few queries regarding blowlamps, one reader who wrote in recently being under the impression that bottled gas was unsuitable for model work, and suggesting a return to the old "five-pinter." There is of course one very important point to watch when talking about bottled gas. For brazing boilers, the gas should be *propane*, not butane. Butane is generally used for portable cooking apparatus, caravan cookers, etc.; but its heating value is lower than propane, so when ordering the gas cylinder (which may be described as a Calor Gas cylinder) be sure that it is propane.

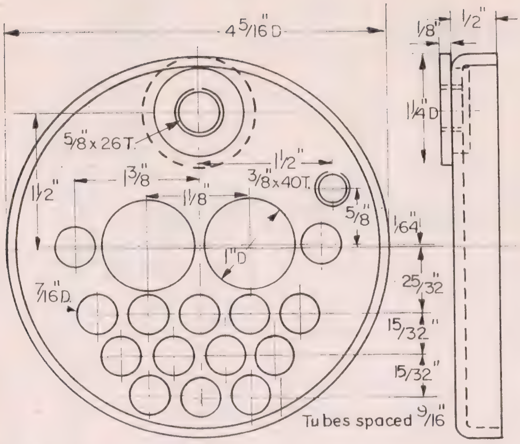
The blowpipes supplied for propane and manu-



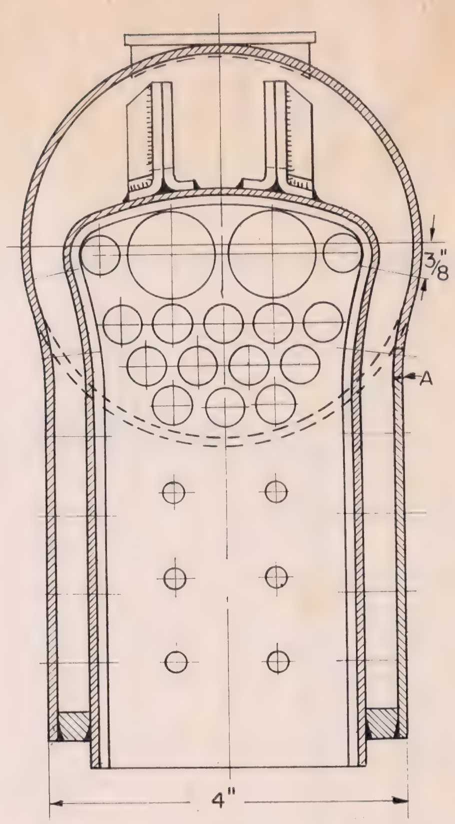
factured by Sievert-Primus (these two well-known manufacturers have apparently amalgamated) are perfectly satisfactory for model boiler work, and in my experience, the best burners to get for a medium-sized 5 in. gauge boiler are the second and third largest in the range. I think it is a mistake to use the largest burner of all, as although this supplies an enormous amount of heat, the flame itself is really too large and diffuse, so that it is difficult for the builder to see what is going on at the "reception" end. Apart from this, the huge volume of heat is enough to melt the buttons off one's overalls!

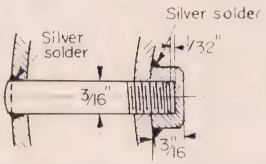
While I would agree that the building of a 5 in. gauge (or larger) locomotive boiler is a much lighter job for two people rather than one, it is quite possible to tackle it single-handed. With all except the very largest boilers, it is only the final "braze-up"—that is the foundation ring and backhead joint—that is likely to be a problem for the lone hand. The solution here is to get two burners going together. I well remember doing my 5 in. gauge *Firefly* boiler at our old workshop at Noel Street; I had a good air/town gas blowpipe in one hand and a Sievert propane blowpipe in the other, to do the final joints, the fluxing and the application of the silver solder being done while the second blowpipe was temporarily put on a conveniently placed hook!

Now for silver solders and brazing alloys. I see

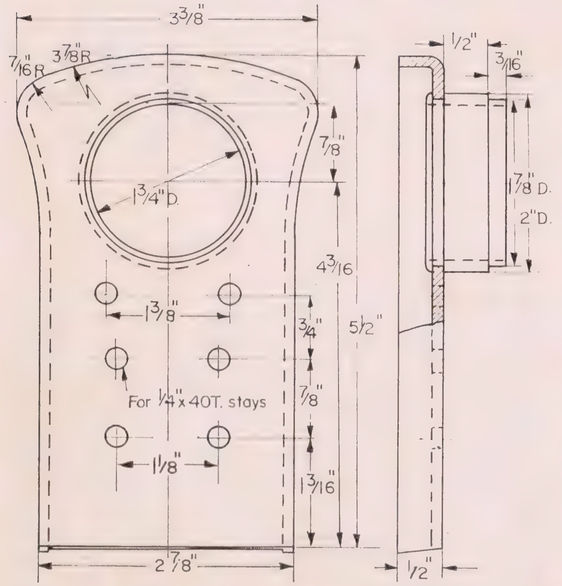


SMOKEBOX TUBEPLATE 1/8" COPPER SHT.

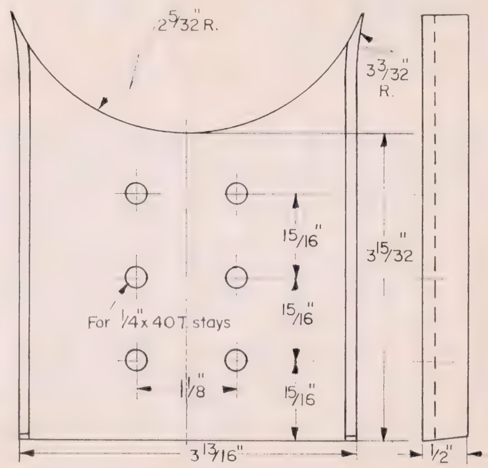




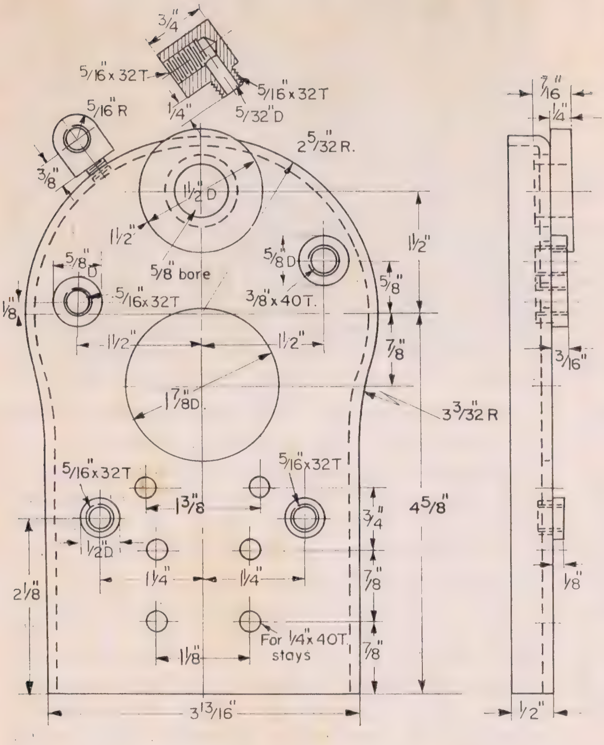
RECOMMENDED TYPE OF FIREBOX STAY MONEL METAL OR G.M.



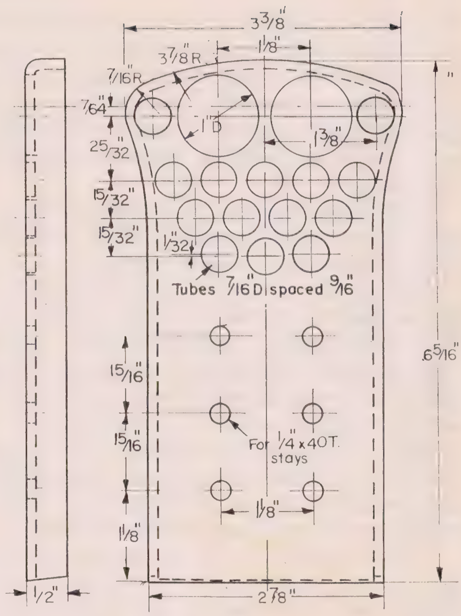
FIREBOX BACKPLATE 1/8" COPPER SHT.



THROATPLATE 1/8" COPPER SHT.



BACKHEAD 1/8" COPPER SHT



FIREBOX TUBEPLATE 1/8" COPPER SHT.

that some builders are again recommending Silfos for model boiler work. I have tried this, but I cannot say that I like it, and I would once again recommend the use of the more expensive low-melting point silver solders to anyone except the really experienced; that is Easyflo No. 2 (or its equivalent from other manufacturers) for the tubes and bushes, Argoflo, Argoswift or Argobond for the firebox joints, Argobond, Mattibraze or C.4 alloy for the outer wrapper/throatplate joints. In fact if expense is not too great a consideration, Easyflo No. 2 can be used for the whole boiler, as this alloy will be found to be the easiest to deal with where the builder's heating capacity is not too liberal. If care is taken when placing a few rivets in "strategic" positions, there should be no fear of any parts previously soldered coming apart during the later stages.

Finally a word about pickle baths. There is no need to plunge a boiler that has only just cooled off from "red heat" straight into the acid. To my mind this is a most dangerous procedure, and I could never understand how it came to be recommended in M.E. It is not at all necessary; I always allow my boilers to cool down to very roughly the boiling point of water (with a little experience this can be judged quite easily) and then I prefer to handle the job with asbestos gloves, rather than try to hold it with steel "tongs." If the tongs should slip, the boiler could very easily be badly damaged.

To be continued

"PRINCESS OF WALES" DRAWINGS

L.O.938—Sheet 1—General arrangement, inside and outside frames. Price 50p.

Sheet 2—Buffer and drag beams, frame stretchers, axleboxes and hornblocks, driving wheels, crankshaft and eccentrics, motion plate, mechanical lubricator driving arm and cylinder details. Price 50p.

Sheet 3—Details of cylinders, crossheads, connecting rods, Stephenson valve gear. Price 50p.

Sheet 4—Details of reversing gear, cylinder drain cocks, details of the bogie. Price 50p.

METALLURGY
IN MODEL ENGINEERING
M. Woodington

Part III *continued from page 129*

THE AREA bounded by the lines B.E.G. represents the alloys which are solid solutions of copper in silver identified by the Greek letter β. The alloys within the area A.C.D. are partially liquid and partially solid solution α, while those within the area B.E.D. are partially liquid and partially solid solution β.

Lines F.C.D.E.G. are the boundaries of the alloys which are completely solid and are mixtures of α solid solution and β solid solution.

Each of the different types of atomic structure in the diagram are called phases, so we call the α solid solution the α phase and so on. The area of each portion of the diagram represents the temperatures and compositions over which these phases can exist and these are called phase fields.

We will now put the diagram into use and discover its practical purpose in the determination of the properties of the various alloys listed below which are also numbered on the diagram.

1. Pure copper. If we look at the line representing 100 per cent copper, we see that it is totally liquid above 1,083 deg. C. and totally solid below; it does not pass through any phase changes and is of f.c.c. structure right down to room temperature.

2. An alloy of 50 per cent copper and 50 per cent silver. Here the alloy is completely liquid down to 870 deg. C., partly liquid and partly solid from 870 deg. C. down to 780 deg. C. and completely solid from 780 deg. C. down to room temperature. Between 870 deg. C. and 780 deg. C. the solid is α solid solution, i.e. some silver dissolved in copper. Below 780 deg. C. there is a mixture of α solid solution and β solid solution, i.e. some areas are mainly copper, containing some silver and other areas are mainly silver, containing some copper. (Appears as in Fig. 9.)

3. An alloy of 71 per cent silver 29 per cent copper. In this case, the alloy is completely liquid down to 780 deg. C. and from 780 deg. C. down to room temperature it consists of a mixture of α and β solid solutions.

4. An alloy of 5 per cent silver 95 per cent copper. This alloy is completely liquid down to 1,060 deg. C., partly liquid and partly solid between 1,060 deg. C. and 990 deg. C. and completely solid α solid solution between 990 deg. C. and 720 deg. C. Below 720 deg. C., the structure changes to a mixture of α and β solid solutions.

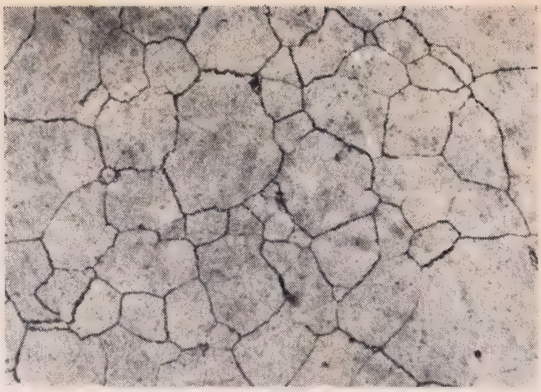


Fig. 5c: An example of a single solid solution, showing grain boundaries.

Let us now examine what these observations tell us and how we recognise them in practice.

Example 1 is a pure metal and has a face centred cubic lattice structure over the whole solid temperature range. It also solidifies or melts completely at a single temperature as all pure metals do, in this case at 1,083 deg. C.

Alloy 2 of 50/50 composition does not melt or freeze at a single temperature, it does so over the range 870 deg. C. to 780 deg. C. This shows why some alloys become " pasty " before becoming completely liquid when heated. This 50/50 alloy is characteristic of the sort of silver solders which are good at filling gaps in joints because the solid portion bridges the gap while the liquid portion gives sufficient fluidity for the alloy to be fed along the joint line, before cooling causes it to become completely solid. This sort of alloy is therefore worked in the pasty region between 870 and 780 deg. C., to take advantage of these characteristics. Another example of this alloy type is plumbers' solder, an alloy of lead and tin with a similarly shaped diagram. When in the pasty condition this alloy can be wiped around a pipe joint.

It should also be noted that there is a gradual change in the amount of solid present, between 870 deg. C. where there is little solid and 780 deg. C. where there is mostly solid and little liquid. The fluidity of the alloy can in consequence be varied by altering its temperature between these two limits. It can also be noted that the alloy is completely liquid at a temperature below that of the melting point of either of the two pure metals from which it is made. In addition, it has been shown that mixtures of two phases are stronger than one. When completely solid therefore, this alloy consisting of a mixture of α and β solid solutions will be stiffer to work and mechanically stronger than either of its two parent metals.

Alloy 3 can be seen from the diagram to be the only alloy composition between the two pure metals which solidifies completely at a single temperature

and such an alloy is known as the eutectic composition. Its other characteristic is that it is the lowest melting point alloy possible in this system and is considerably less than its two parent metals. Its solid structure is 2 phase (mixture of α and β solid solutions) so it is strong. This alloy is characteristic of the silver solders which melt at low temperatures and are not good gap fillers, because they are either completely liquid or completely solid and there is no halfway stage. The low melting point is however convenient in some applications. Since they do not become pasty they are very fluid and are very searching in use and will penetrate very small joint clearances.

Another use for such eutectic alloys is in casting where their good fluidity ensures accurate reproduction of the mould shape and the absence of a freezing range produces castings of low porosity.

Alloy 4 is characterised by a high melting point with a small pasty range, but its most important feature is that its structure changes on cooling from one containing only a single solid solution (above 720 deg. C.) to a 2 phase one below this temperature. Compositions which show such changes are important since they indicate alloys, in which changes in the room temperature properties (strength, hardness, etc.) can be brought about by heating and cooling through the phase change temperature—heat treatment.

Many of the commercial alloys used in industry contain more than two metals, three or four alloying elements being quite common. The same principles apply to these, as to the two metal system described above. Eutectics, for example, can be formed in the same way between four metals as two. There is no need to go into details; it will suffice to say that the addition of a third or fourth metal to a two-metal alloy will raise or lower the melting points and phase change temperatures of the basic system. Compositions will also be shifted slightly. In this way complex alloys are built up.

One example will however be useful. It was noted above that the copper-silver system forms the basis of the silver solders and the lowest melting point shown in the diagram is 780 deg. C. This alloy is available commercially, when it is known as " silver-copper eutectic." It is widely known that the common grade of silver solder melts at 630 deg. C., and this is obtained by adding zinc and cadmium to the basic copper-silver alloy. A typical composition is as follows:

50 per cent silver; 15.5 per cent copper;
16.5 per cent zinc; 18 per cent cadmium.

Alloys containing two metals are called Binary alloys, three metals Ternary, four metals Quaternary and so on.

To summarise progress so far: The construction of metals and alloys and how this changes with temperature has been discussed in relation to the component parts—atoms. The way this information can be presented in the form of an equilibrium diagram has been explained, as has a basic theory of slip in the deformation of metals. If I have succeeded in giving an understanding of these principles, future extensions of theory to explain the reasons for sound practice should not be too difficult.

Working and annealing copper and brass

Having covered some basic metallurgical theory in my preliminary article, we can make a start on the first of the more practical topics into which some metallurgy can be interwoven.

The subject chosen is one which frequently causes the model engineer a good deal of heartache (and arm ache) in the construction of boilers and platework. Both copper and brass are expensive materials and scrapped components are therefore to be avoided. In addition, boilers are pressure vessels and potentially dangerous weapons if poor quality materials or workmanship are included. The regulations applying to the construction of full-size pressure vessels are detailed and precise with good reason.

Many more clubs are insisting on regular testing of boilers these days and this goes a long way towards ensuring safety in operation. Nevertheless the time and materials put into the construction of a boiler, which fails its hydraulic or steam test, can be completely wasted. The more that is known about the effects our " hammerings and heatings " have on metals, the more likely we are to produce components which are of adequate quality and pleasing appearance.

To start with, a definition of the alloys covered by the names copper and brass, will be useful.

Copper is normally regarded as a " pure metal " and the term is used to differentiate such metals from alloys which are the result of intentional mixing of two or more metals in significant proportions, to produce specific properties. The coppers which are provided for normal commercial sale, contain in general greater than 99 per cent copper, but the remaining 1 per cent may be made up from a balance of residual impurities and intentionally added elements. They are then only loosely covered by the term " pure metal."

The purest of the coppers is the High Conductivity grade, which has a minimum of 99.95 per cent copper and the range goes down through tough pitch grades, which contain some oxygen in the form of copper oxide, to those containing phosphorus or arsenic. Phosphorus is added in melting to reduce the oxide content. Arsenic con-

taining grades have slightly improved cold and hot mechanical strengths and resistance to scaling during heating. For these reasons this grade has been used in full-size locomotive fireboxes. All of these grades have specific uses in industry, where special requirements of electrical conductivity, etc., demand use of a single grade. For model engineering purposes, however, any of the grades are normally acceptable and they will all be referred to in later paragraphs as " copper."

Brass on the other hand, is a name covering a whole range of materials, in which there are significant differences in properties depending on composition. All the brasses are alloys of copper and zinc but the zinc content can vary between 10 per cent and 50 per cent. There are however two groups of alloys which are used for the vast majority of engineering requirements and cover virtually all the constructional requirements of the model engineer. One is a series of alloys containing between 30 and 37 per cent zinc, from which nearly all the sheet, strip and plate material is made, the other is nominally 40 per cent zinc used for the majority of bar-stock. The latter usually contains 3 per cent lead to improve machinability.

The two alloy types have quite different properties, designed in the first case primarily for optimum cold formability and in the second case for rapid and good mechanical strength.

It will also be useful at this stage in the proceedings, to briefly define what is meant by some of the various terms relating to mechanical properties of materials.

Ultimate Tensile Strength (U.T.S.):
The stress (load per unit area) usually in units of tons/in^2, which is required to cause fracture under a tensile stress. Often loosely called " strength."

Yield Point or Limit of Proportionality:
The stress at which the material just begins to show plastic deformation or permanent set.

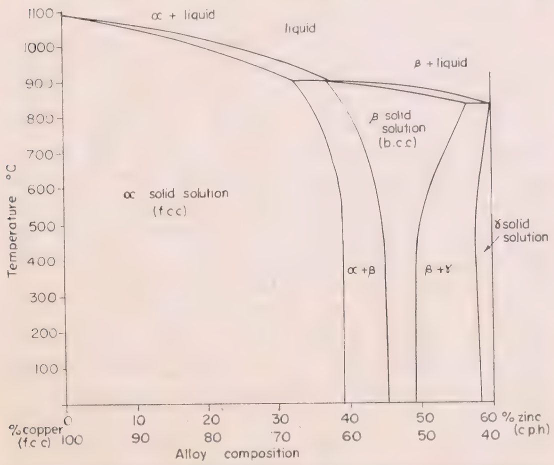


FIG. 13 EQUILIBRIUM DIAGRAM FOR COPPER-ZINC ALLOYS (BRASSES)

Ductility. In tension, the amount by which the metal is stretched before failure occurs (per cent Elongation).
In bending, the angle to which a metal can be bent around a former of known radius before cracking starts.
In shock loading, the energy measured in ft. lb. which is required to break a specimen of the material by a transverse shock load. One common test of this type is called an Izod impact test. The higher the figure, the more ductile or shock resistant—the lower the figure the more brittle.

Hardness. The resistance to indentation or scratching, when a pointed tool is applied to the surface of the metal. Small mark—high hardness figure.

Structure of copper and brass

We have seen from the first article in this series and from the introduction above, that copper as a pure metal is of one lattice structure throughout the temperature range in which it is solid. This face centred cubic (f.c.c.) arrangement of the atoms is not affected by the small amounts of phosphorus, arsenic or oxygen which are often present in the commercially-available metals. Since they are small amounts, they either pass into solid solution in the copper, or exist as extremely fine particles of, for example, copper oxide and in this quantity do not significantly affect the properties with which we are concerned here.

The amount of zinc present in copper to form brass is however significant and to observe its effect on the structure of the alloy, the equilibrium diagram for the two metals needs to be studied and this is shown in Fig. 13. By applying the knowledge gained from the first article, it can be seen that at room temperature, it is possible to hold up to approximately 38 per cent zinc in solid solution in copper. Consequently, alloys up to this composition will have the same lattice structure (f.c.c.) as copper and have similar forming properties. We also notice from Fig. 13 that while copper has an f.c.c. structure, zinc has a close packed hexagonal arrangement of atoms and in alloys containing equal proportions of the two metals, the atoms prefer to take up a body centred cubic arrangement. In fact, in the copper-zinc system, there are many phases formed, particularly at the zinc rich end and there are many different atomic arrangements possible. To avoid unnecessary complication, only the portion of the diagram between 0 and 60 per cent zinc has been shown, to cover normal commercial alloys. In this part of the system there are three types of solid solution which can exist; copper rich alloys are f.c.c. α solid solution, and as the zinc content is raised there appears β solid solution b.c.c. and

γ solid solution which has a complex cubic structure. In passing from left to right in the diagram, each new phase which is formed is harder and more brittle than the last, because it tends towards the inherently brittle structure of pure zinc. In addition we have seen that the b.c.c. structure of β solid solution is less easily worked than the f.c.c. of α solid solution, because it has less slip planes. In between these alloy ranges in the diagram are compositions which are mixtures of two solid solutions and the properties of these are also intermediate.

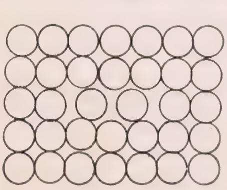
In the copper zinc system then, alloys from very ductile to very brittle can be formed and we find marked changes in this property on crossing the lines of the diagram from one phase field to another.

It is now possible to see why the brass alloys made in sheet form for bending and forming are compositions in the α solid solution range. These 30-37 per cent zinc alloys are the strongest alloys which have the fully ductile f.c.c. structure.

Directly the zinc content is raised above 38 per cent, the two phase α and β region is entered and the tensile strength rises and ductility drops due to the presence of the harder constituent. Machinability is improved on this account and these alloys have the best compromise of machinability, strength and ductility for the majority of structural engineering parts machined from the solid. Brass in bar section form is therefore nearly always of the 40 per cent zinc two-phase type. The 3 per cent addition improves the chipping properties in machining without markedly affecting other properties. It is insoluble in the brass and exists as small islands of lead in the copper-zinc structure.

Alloys with higher zinc content than about 40 per cent are too brittle for general engineering purposes. The only alloy of such a type which is used at all is a 50/50 alloy as a brazing filler rod.

It should also be noted at this stage that there are two principal ways in which engineering alloys may be hardened; by heat treatment (quenching, etc.) or by mechanical working (deformation). All materials which may be hardened by heat treatment undergo a phase change e.g., f.c.c. to b.c.c. at some elevated temperature, and it is this change which is responsible for the hardening action. The degree



ATOM ARRANGEMENT AT A DISLOCATION FIG. 14

of hardening produced varies from alloy to alloy, but in steel for example the action is particularly marked. Alloys in which there is no phase change e.g. sheet brass, cannot be hardened by heat treatment and this must be accomplished by cold working.

Working

The methods of working metals may be classified into two groups, cold working and hot working. There is a precise definition of the difference between these two, but it will be easier to leave this until later. For the moment we will consider that cold working refers to forming processes carried out at room temperature and hot working to those carried out at red heat.

Cold working

We have seen that both copper and sheet brass are f.c.c. and easily worked cold. In the previous article, this characteristic was attributed to the slipping of one plane of atoms over another and that because f.c.c. structures had more planes suitable for slip than other types, they were the easiest to work. While this is true in general terms, it is not the complete story, for it does not explain the mechanism of work hardening. Everyone who has flanged boiler plates knows that after a certain amount of work has been put into the metal, it hardens and needs annealing before the job can be completed. To explain this phenomenon we have to take account of the mechanism of dislocations. Previous diagrams show that atoms are arranged in regular rows, built up from many adjacent lattices and that in each grain the lattice directions are constant, only changing at a grain boundary. What has yet to be mentioned is that there are occasional local faults in such regular arrangements of atoms and at these points the structure is said to be dislocated or the site is called a dislocation (Fig. 14).

Calculations have shown that from the atomic bonding forces, a perfect metal crystal with no lattice faults would have mechanical strengths far higher than those which are measured on normal commercial materials and that these theoretical properties could be obtained by the sort of block slip mechanism which was explained in the earlier article. In such a perfect crystal, work hardening would not occur. In practice, with commercial materials, many dislocations or local faults are present. Hence, instead of a complete plane of atoms slipping "en bloc" over one another, deformation occurs by the movement in any row of atoms of one atom at a time and one after another. In this way a dislocation moves about in a crystal in a similar way to a ripple travelling across a pond.

To be continued

IN THE WORKSHOP

A Dividing Head

by F. Skelton

MANY MODEL MAKERS, sooner or later, find the need for a dividing head, especially if some gear cutting is to be done; but more frequently it is only required to perform a few simple operations.

The attachment to be described was designed for this latter kind of work and to be used on the vertical-slide of the lathe. It has proved itself as a great time saver in addition to producing accurate work.

It accommodates bar work between $\frac{1}{8}$ in. and $\frac{1}{2}$ in. dia. for the cutting of squares, hexagons, reamer flutes, keyways and cotter slots. Most components can be conveniently finished whilst still attached to the parent stock and then parted off.

As the lathe was already equipped with Myford collets, it was decided that the dividing head should accept the same collets. Other types of collet can equally well be used by making the mandrel bore to suit.

A glance over the accompanying drawings shows that all the parts can be produced on a lathe and only two iron castings are needed.

For the assistance of any readers desiring to make a dividing head the following notes may be helpful.

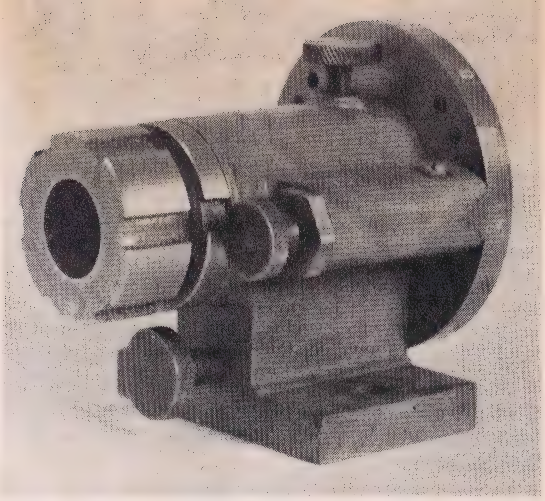
Firstly a pattern for the body will have to be made. This should preferably be a two piece type divided on the vertical centre-line. It is desirable to have a liberal taper on the underside of the base, and $\frac{1}{8}$ in. should be added to the faces which will be machined. There need be no cored holes.

When the casting has been obtained it should be the first item for machining. Follow the operations as for a cylinder block, many times described in M.E.

The mandrel should now be tackled. Any alloy steel will be suitable, the one illustrated was once part of a car axle. Firstly cut off a piece about 2 in. longer than the finished length and anneal it if found too hard to turn easily. Then rough turn all over and bore under size. Lay this aside and do the same to a piece of mild steel and remove from the lathe chuck.

Now for setting over the top-slide for boring the taper, use one of the lathe centres as a reference. This will have to be mounted with its point towards the tailstock. To support the point, turn down a piece of $\frac{7}{8}$ in. bar about $\frac{1}{8}$ in. along to fit the tailstock plunger, accurately drill up the end a $\frac{3}{16}$ in. hole $\frac{1}{2}$ in. deep and part off a disc about $\frac{3}{8}$ in. thick and press into the tailstock plunger.

Take off the chuck and insert the lathe centre



into the lathe mandrel. The other centre can now be mounted with its small end to the headstock and the pointed end in the tailstock. Clamp a flat-ended tool in the top-slide and with a dial indicator or a set of feeler gauges set the top-slide dead accurate and keep this setting until the mandrel is finished.

Put on the three-jaw chuck. Here is a tip if the jaws are bellmouthed: wrap a narrow strip of paper around the steel to be turned, where the front of the jaws will grip.

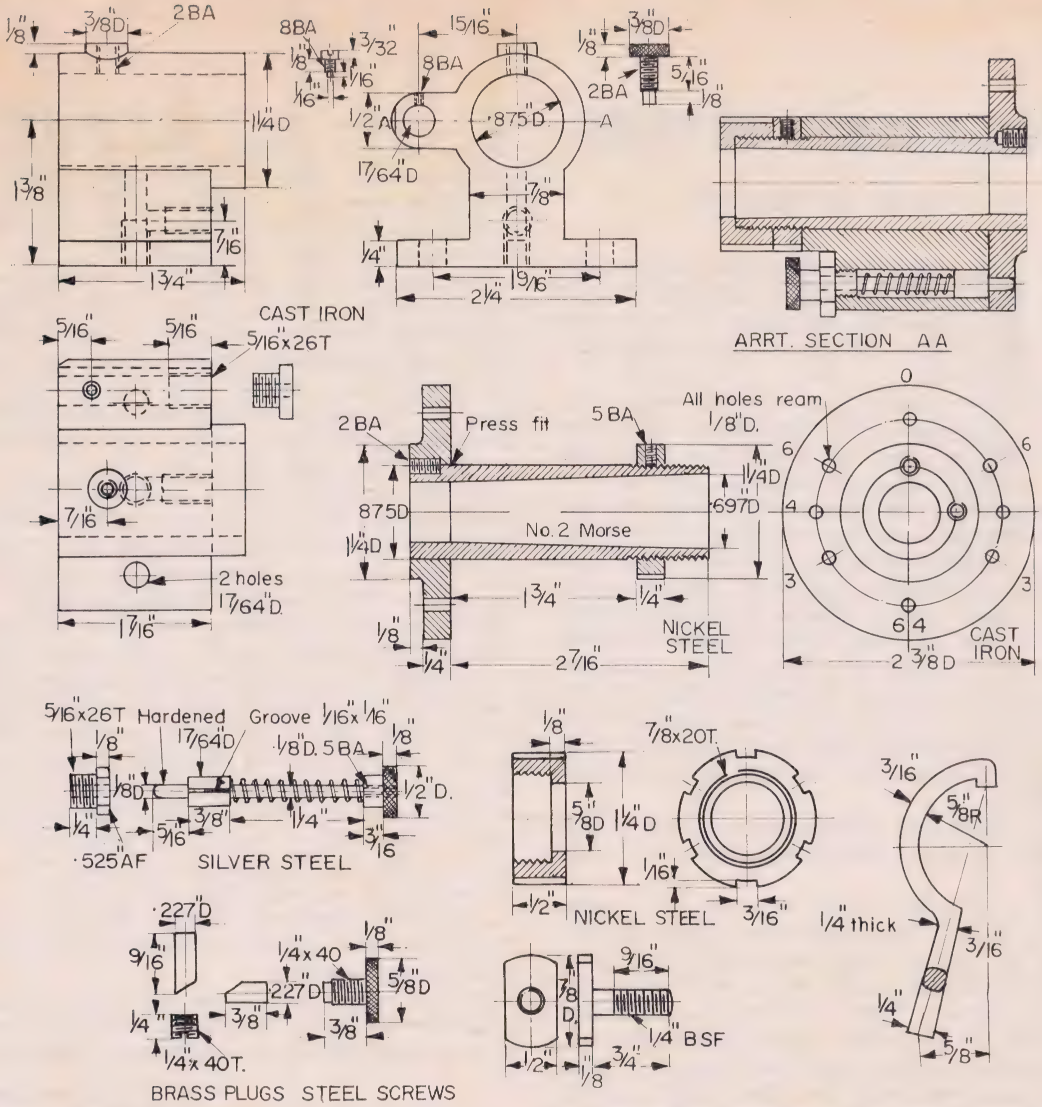
Chuck the mild steel blank and bore the hole taper undersize. Make sure the cutting edge of the tool is exactly at centre height. Test with the lathe centre. If due care has been taken in the setting of the top-slide, it should fit satisfactorily. If not, take off the boring tool, put in the flat ended tool and bring it against the outer diameter of the work, tap over the top-slide at the end of its travel, measuring with a cigarette paper, and bore again.

When the lathe centre is a good fit, replace the mild steel by the alloy steel, turn and finish with a nice smooth close fit in the cast-iron body, then bore to finished size. Make sure the mouth of the bore is exactly the same as the end of the lathe mandrel.

The screw thread can now be cut, using a single point tool. It will be advisable to support the work in the tailstock centre. This can be done by using the setting pad already made but this time pressed into the taper hole in the work. Part off to length and the mandrel is finished.

Finally when the dividing plate has been turned, press it on to the mandrel and secure by two grubscrews and assemble it into the cast-iron head. The indexing holes will be drilled through the detent hole.

To drill these index holes: make a bush with a No. 31 hole and push it into the detent hole. Fix a 60-tooth gear wheel to the back of the dividing plate by means of an adaptor and a long bolt through the mandrel hole. Improvise a detent on a piece of angle fixed to the underside of the cast-iron body, this kind of operation has often been



described in M.E.

Now spot drill a No. 31 hole into the dividing plate and mark it "O". Repeat the drilling at every ten teeth. Start again at "O" and drill two more holes at 15 and 45 teeth.

Take out the mandrel and complete the drilling and ream ⅛ in. dia. Mark the holes as on the drawing. The lines on the edge can be dispensed with, but if they are desired cut them with a tool held in the four-jaw chuck with the completed dividing head mounted on an angle plate on the vertical-slide, indexing the positions by its own dividing plate.

Lastly there is the 2 BA hole where the knurled screw is. Set the fixture at "O" and drill a No. 31 hole through the mandrel. This is for locking the mandrel when screwing up the collet. Note: by drawing the detent back far enough it can be turned to hold itself clear of the dividing holes. Likewise the ¼ in. screw in the base is for locking the mandrel when any heavy milling is to be done.

A few notes on the use of the dividing head will not be out of place here.

To obtain accuracy when milling squares and hexagons: Go around the four or six stations to cut oversize, measure to find the difference between this and the required size, traverse the lathe lead-screw half this amount and index around again.

To cut cotter slots, the end mill must be exactly over the centre of the work. To set this, use a piece of rod in the lathe chuck the same diameter as the end mill and move the vertical-slide until the two line up together. Keep this setting throughout.

To cut the slot, put a small centring drill in the lathe chuck, index to zero position by the cross-slide dial and spot the centre. Now index to 4-6 and spot again. Move the cross-slide the desired amount and spot centre at both sides again. Note the two readings and do not forget the backlash.

Continued on page 193

TOOLMAKERS' BUTTONS

by G. E. Savage

TODAY with more and more machine tool operations being done by computers or programmed by taped instructions, there is a real danger of the simpler yet quite accurate methods of work being either lost or obscured.

Especially is this true in regard to much of the small engineering work being done by both men and women as a rest and a relief from the stresses and strains of modern work-a-day life. It is to be regretted that few seem to fully realise that very often there are two ways of doing a job—a very elaborate multi-tool way and a simple but quite efficient way taking a little more time *but* giving quite a lot of personal pleasure in the doing. Many readers will remember those—sometimes bitterly sarcastic but always true—pictures of a man surrounded by weird and wonderful gadgets—" Look I made that to make this!" *This* being something quite simple which actually could have been made in less time than it took to make the jig or what-have-you.

An old but very efficient way of setting out sets of holes is not as well-known today as it ought to be.

The problem arises—how to set out two or more holes in a job to near Class 1 limits without elaborate tools, etc. The old toolmakers kept in their boxes a set of " buttons," made out of tool steel—sometimes hardened. These were made to a standard accurate size and length. For the small workshop a set could be made quite easily from ½ in. silver steel. Six pieces should be made exactly 1 in. long —the ends faced true and square—four would be drilled ¼ in. and two very carefully drilled and reamed 3/16 in. dia. These holes *must* be straight and true. If there is an error in the lathe chuck, then use the time honoured method of making a split bush in the chuck, or make simple collets to fit the lathe nose bore. Six Allen cap screws 3/16 in. dia. × 1¼ in. long, plus six bright steel washers to fit, are required to fasten the buttons.

The required holes are now very carefully set out with a scriber and rule, punch-marked carefully and checked. Drill each centre 3/16 in. tapping size. Check and recheck before finally drilling into the job. Sometimes, as in the timing gear of a four-stroke petrol engine, the measuring is taken from the crankshaft hole, which is fitted with an accurate plug from which to measure.

Once the required holes are tapped, the buttons are fixed lightly in place. In some cases the button with the 3/16 in. hole will be fixed first in one hole from which all other measurements are taken (for instance, the holes in a geared apron for a lathe).

Next the centre distances have to be carefully checked. This is done in one of several ways: (a) if a " standard " is available—say the outer ring of a ball race, then using calipers over the buttons put in a thin piece of tissue on one button and measure with calipers until the paper can be drawn out gently. This is an indication that the calipers are neither slack nor tight. For larger spaces, check with calipers using a magnifying glass unless a vernier caliper can be borrowed. (b) Sometimes a number of ball race outer rings can be found in a wreckers yard—these are of little value and the *English* sizes will make up a useful set in multiples to any required length.

Once the buttons are all lined up, the job is fixed in the four-jaw chuck or bolted on the lathe face-plate and each button in turn (having been tightened

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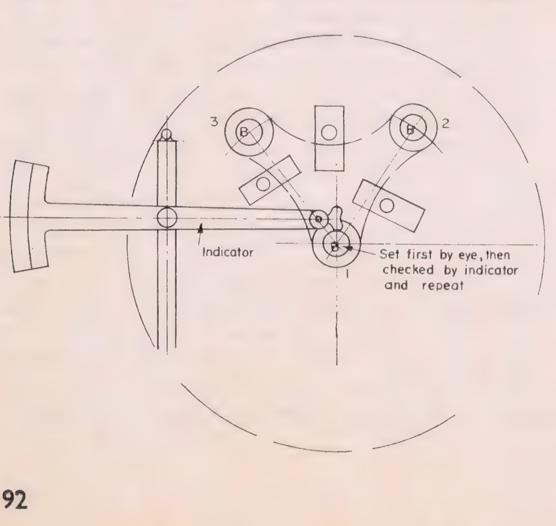
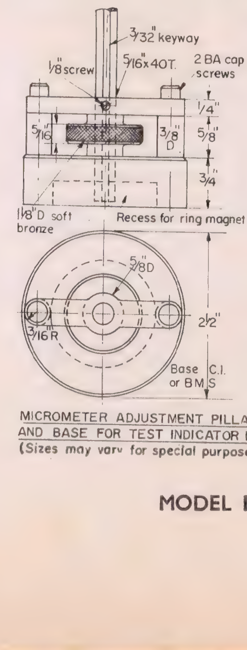
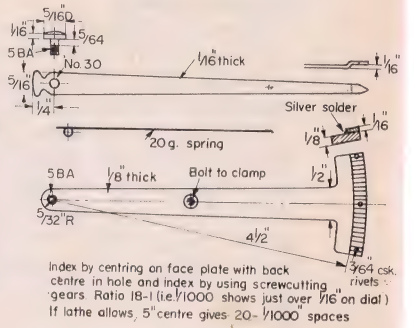
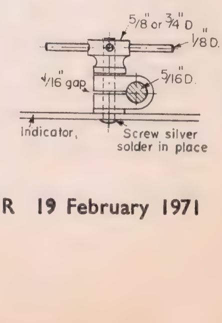




MICROMETER ADJUSTMENT PILLAR AND BASE FOR TEST INDICATOR ETC. (Sizes may vary for special purposes)



TEST INDICATOR

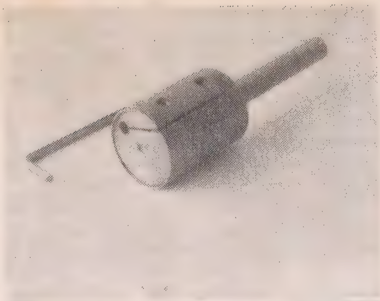


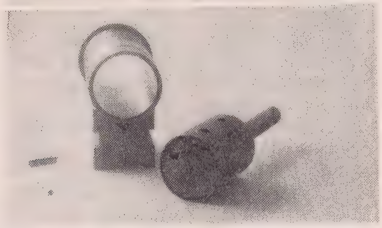
METHOD OF CLAMPING THE INDICATOR

A PARALLEL ADJUSTABLE LAP

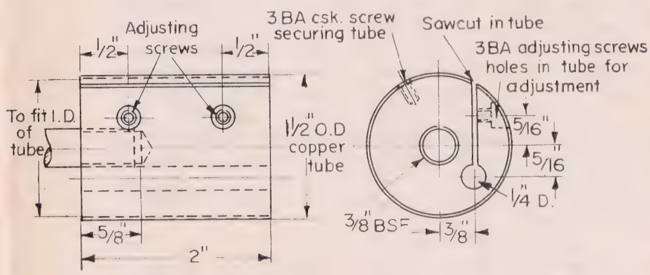
by

R. R. May





HAVING MR WESTBURY'S *Centaur* gas engine under construction, the question of a lap for the cylinder liner arose. I do not like taper adjusted laps for long bores, so a lap with a parallel adjustment was decided on. Since the liner was a one-off job only, a lap requiring less expenditure of time and material than the usual rather elaborate parallel adjusted ones was looked for. The result of thought in this direction finally ended up as the article described. It is quick and easy to make and was very successful for its purpose, producing an accurate and well finished bore which can be seen in the photograph besides the lap.



The lap proper is a piece of 1½ in. o.d. copper tube, cut along its length and a push fit over a similar or somewhat shorter length of b.m.s., machined to the i.d. of the unslit tube. The body is drilled through its length ¼ in. dia. and a lengthwise saw cut made down to this hole as shown on the sketch. Adjustment is made with the 3 BA grub-screws. The copper tube must be secured to the body on the opposite side of the slit in the tube to that of the adjusting screws and access to the latter for adjustment is made through holes cut in the tube. A ⅜ in. dia. mandrel is screwed into the body to enable the lap to be held in the lathe chuck, the work being held in the hand for the lapping process.

The dimensions given apply only to a 1½ in. dia. lap of the length shown, of course. They would have to be suitably modified for laps of other diameters and lengths. An important point is the thickness of the metal between the ¼ in. dia. hole in the body and the surface of the latter, as this determines the stiffness of the "hinge." It should be reduced if the lap diameter is reduced and increased if the diameter is increased, assuming one adjusting screw per inch of length.

Finally, a tip for cleaning out the taper seats for lathe centres, etc., in lathe mandrels. Take a wax candle of suitable diameter and length. Pare it down and work it into the taper bore so that it fits accurately into the full length of the taper part. It takes a little time and patience but it can be done. Then, to clean your mandrel bore of swarf, etc., push this taper wax plug into it and then withdraw it with the bits embedded in the wax.

TOOLMAKERS' BUTTONS

fully) will be set to run true. A test indicator as drawn is suggested as an aid. With its special micrometer pillar, a very accurate test can be made. This is only an outline of the principles involved. A fully geared lathe apron with a worm to the second feed shaft was made in this way—patience plus care resulted in every shaft fitting perfectly and all gears have run sweetly for over 15 years.

Naturally, as each button is running true, it will be taken off, but even then great care must be taken in the first operation not to disturb the job, or drill with badly ground drills.

Patience and again patience will give Class 1 results. No piece-work here, just the joy of making something that is really good. ▣

DIVIDING HEAD

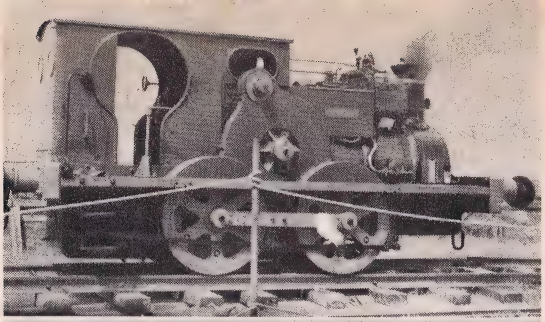
Continued from page 191

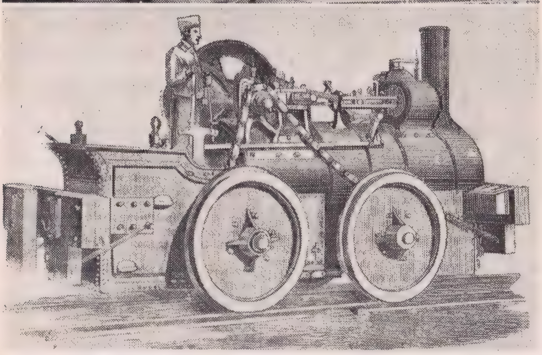
Replace the centre drill by a twist drill the same diameter as the width of the slot, and repeat as with the centre drill for a depth of half the work diameter.

Replace the drill with the slot cutter and traverse to and fro between the holes for half the work diameter, re-index and repeat. Let the feed be about .005 in. and the speed about 2,000 r.p.m. if you can get so high.

These end mills will usually be very small and can be easily made from $\frac{3}{16}$ in. dia. silver steel.

Turn the end the required diameter for a length of about the work diameter, file a flat for half this length making the D shape half the cutter diameter, harden and temper. Grind the tip about 5 deg. rake in both planes making a point of about 85 deg. at the leading edge. ▣





Top: Aveling & Porter geared locomotive "Sirapite," now preserved in working order.

Below: An early Aveling & Porter chain-driven engine adapted for use on rails. From "English Mechanic," 1866.

JEYNES' CORNER

E. H. Jeynes writes about traction engines as locomotives

IT WAS REALISED very early by some quarry owners, that locomotives of the ordinary type running on rails had limitations, being only available for the purposes of haulage, or supplying steam for some static purpose. The traction engine, however, with its overtype motion and flywheel could also be employed to drive machinery by belt. Usually such machines were small stone crushers, or revolving screens which could be fixed in different parts of the quarry, the engine being brought to it. This resulted in traction engines being adapted to run on existing systems of rails within the quarries; thus they were able to fulfil two purposes.

Gray's Chalk Quarries in Essex, were one firm to order traction engines from Aveling and Porter, specially adapted to run on rails, and notwithstanding the fact that the engines were limited in operation as they were on rails, they were undoubtedly very successful, as in addition to the first two engines supplied, a third was ordered and delivered in 1886. The cost of these engines was £530 each.

Particulars of the third engine were as follows: The motion work was easily accessible on top of boiler, the single cylinder 10 in. bore × 12 in. stroke was steam jacketed; the rated output of the engine was 10 nominal horse power. The crankshaft was geared to the second motion shaft by spur gearing; this shaft carried a chain sprocket which carried a chain passing round chain wheels on each axle bolted to driving wheels, in a triangular form of drive. Means of adjustment of the chain was provided by radial slots in the main brackets, the bearings of the second motion shaft riding in these were capable of being raised or lowered, while the mesh of the gear teeth was kept at constant depth. The four driving wheels were 4 ft. diameter. I can find no mention of any brake.

The boiler was of the ordinary locomotive type, the firebox having a grate area of 7½ sq. ft.; and there were 66 tubes of 2¼ in. external diameter. The boiler was fed by a pump driven by the crankshaft. The safety valve was of the Salter spring balance type. The water was carried in two tanks, one below the boiler barrel, and the other below the bunker and footplate; the capacity of the two was 350 gallons. The coal bunker could take about 10 cwt. of coal.

The principal job these engines were engaged upon was hauling the excavated material from the quarries to the wharf, a distance of about a mile. At the quarry end, the line divided into two branches, one of these having an inclination of 1 in 36 and 1 in 41, against the load.

Ruston Proctor built a modified traction engine to run on rails in 1869, having a single cylinder 10 in. bore × 12 in. stroke. It had four coupled wheels 3 ft. 6 in. dia. at 4 ft. 9 in. centres. In 1872, Aveling and Porter built two modified traction engines for the Wootton Tramway to Brill. I believe there was an Aveling and Porter engine of this type at the Croydon Gas Works, and also near Croydon at a lime works was an engine which I was told was a Clayton and Shuttleworth and that it was about 70 years old.

An Aveling and Porter geared overtype locomotive was supplied to Mountfield Gypsum Mines in Sussex, and was named "Sirapite" after the sulphate plaster manufactured by this firm. This engine went to Richard Garrett and Son's works in Leiston about 1929, the rampant horse of Kent disappeared from the smokebox front, and was replaced by Garrett's flying Panther. When I last saw this engine under steam in 1965 the Panther had also disappeared, although the nameplate "Sirapite" still remained. This engine is fitted with brakes, and although redesigned with many refinements, the layout does not differ greatly from the engine of 1866. There is a stretcher bar between the axles on this engine to keep gears correctly in mesh, and this has often been mistaken for a coupling rod at first glance. The chimney is shorter on this engine than on several of the other Avelings.

I have records of several makers' excursions into this field of traction engine building, among these are Wallis and Steevens and Lewin of Poole, Dorset. I am not quite sure, but I think two of Lewin's engines are preserved in Dublin, bearing the names of "Malt" and "Hops."

In the Museum at Angel's Camp, California, there is an ancient traction engine, whose layout seems to indicate British origin. This engine I would think dates from 1865 to 1870 and has been rather crudely converted to run on rails for logging purposes, and I believe was abandoned about 1904. From a study of photographs (not good enough for reproduction) I think this engine was built as a two-cylinder simple, the cylinders being low down on the sides of the smokebox, driving a crank disc each side and having no flywheel, and that, to bring the engine down to width, one cylinder was removed, and part of the differential also to allow the rear wheel to be fixed closer to the firebox.

This alteration would make the engine a non-starter or at any rate a very poor starter, so a flywheel from some piece of machinery was fitted on a longer shaft; this flywheel is at least a foot from the main bearing, being outside the rear wheel. For some reason the old steering wheel brackets, drum and chains were left in position. I would be greatly interested to hear from anyone who has closely examined this exhibit, which stands on a short length of rail track.

A Novel Mechanical Lubricator

by Howard MacMahon

THE LUBRICATING oil pump described in this article and shown in the drawing and photographs is believed to have some definite advantages for the model locomotive builder. It was developed with two objectives: firstly to get an alternative which would be mechanically superior to the oscillating cylinder spring-held against a port face, and secondly to make adequate provision against cross-port leakage. Simplicity of construction and elimination of the possibility of functional failure were further aims.

The dimensioned drawing is the design fitted to my $3\frac{1}{2}$ in. locomotive, but the photograph of component parts depicts fundamentally the same pump but somewhat larger (ram $\frac{5}{16}$ in. dia. × $\frac{3}{8}$ in. stroke), built for adding a small quantity of chemical to a large volume of water being applied by hose to a bowling green.

As will be seen from the drawing, the main feature of the pump is an oscillating disc, $\frac{9}{16}$ in. dia. and $\frac{3}{16}$ in. thick, having a diametral $\frac{1}{8}$ in. reamed hole through it forming the pump cylinder. The ram has a stroke of $\frac{1}{4}$ in. although the crank circle is $\frac{5}{16}$ in., there being $\frac{1}{16}$ in. lost motion due to the crank-pin hole being in the form of a slot $\frac{1}{16}$ in. longer than the crank-pin diameter. If desired, the stroke could be further reduced without affecting the operation of the pump, by extending the length of the slotted hole in the ram.

The purpose of the slotted crank-pin hole is to obtain sufficient oscillation of the disc to provide adequate "land" between the ports to prevent cross-port leakage without increasing the stroke of the ram beyond what is desired. The consequent lost motion at the top and bottom of the stroke has a further advantage in that it occurs when the moving port is crossing the "land" between the two fixed ports.

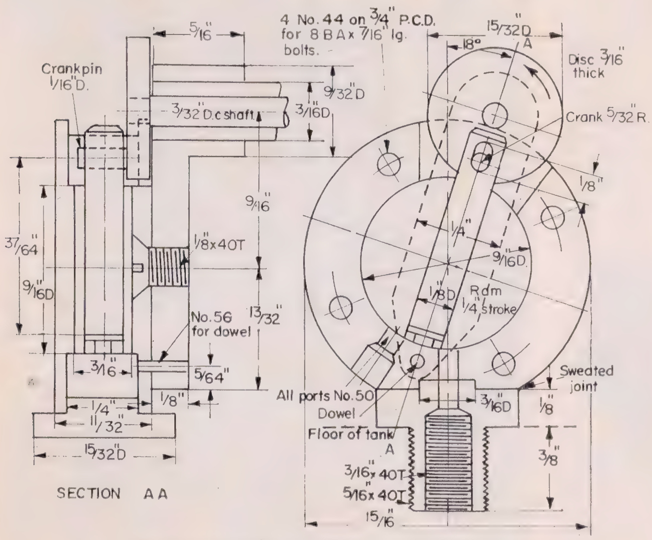
The segment cut out of the part in which the disc oscillates in order to give clearance for the disc crank and the projecting part of the pump ram should be removed prior to boring to $\frac{9}{16}$ in. dia. To hold the housing during boring, I bolted it to a similar piece held in the three-jaw chuck, drilled to match the four bolt holes shown.

It may be noted from the photograph of the larger pump that in this case clearance for the projecting part of the ram is provided in the form of a slot instead of by removing a segment as mentioned above—this is probably better practice but it is hardly practicable within the dimensions of the smaller pump.

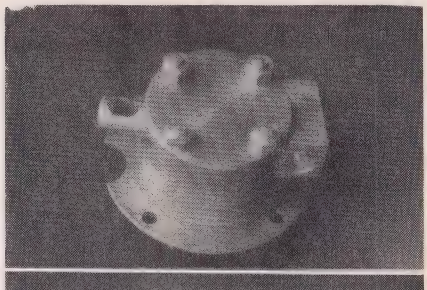
It should be emphasised that the diametral fit of the oscillating disc in its housing should be nearer to a "push-fit" than a "running-fit"—this is essential to the effective operation of this design of pump.

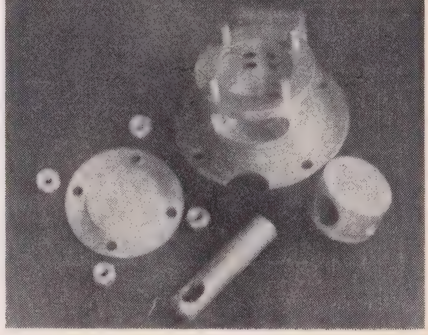
After drilling and reaming the $\frac{1}{8}$ in. bore in the disc and prior to turning the diameter to finished size, a $\frac{1}{8}$ in. plug, drilled No. 50, is fitted in one

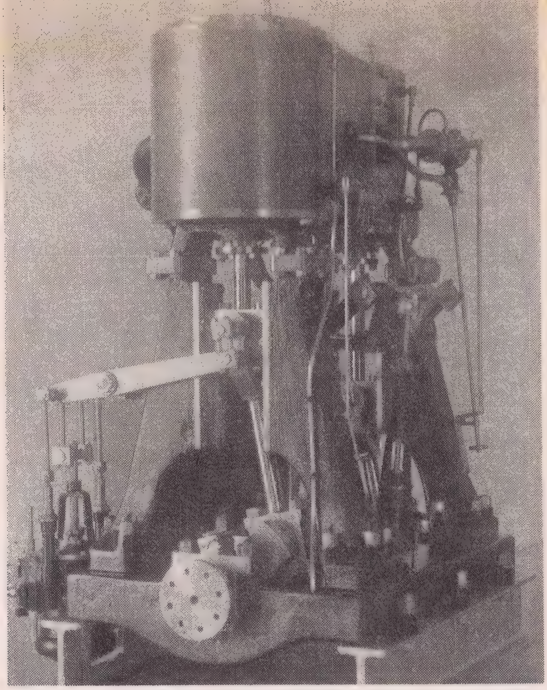
Continued on page 203



OIL PUMP FOR 3½" OR 5" GAUGE LOCOMOTIVE







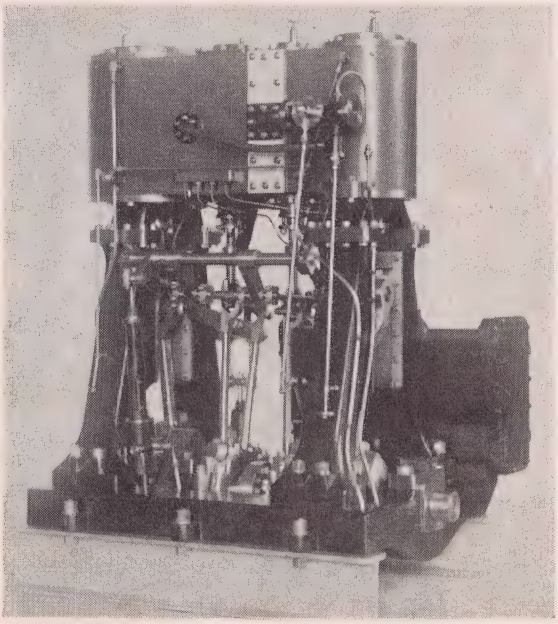
Frank D. Woodall
describes an unusual model marine engine

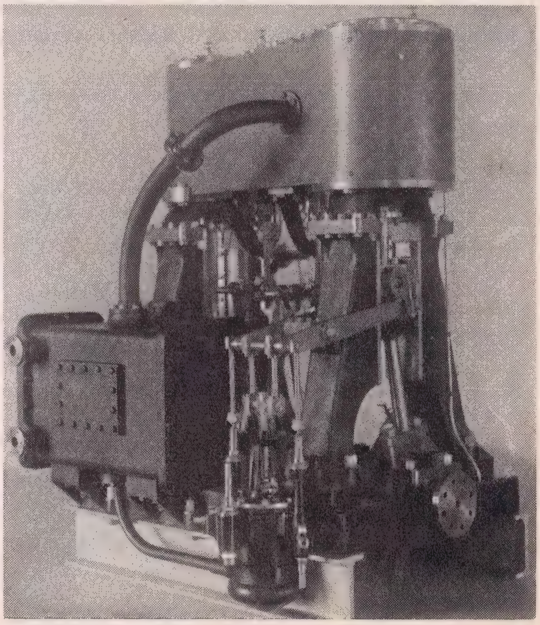
THE PUBLICATION in Model Engineer of these pictures of a small marine engine could be considered as the last chapter in a long story. In 1886 Francis Fearnside, a student at Bradford Technical College, started building one of these engines. What he did in subsequent years I do not know, for I only knew him to be living in comfortable retirement, after he had sold his mill.

It was not idle retirement for besides photography and lantern slide making on the $3\frac{1}{4}$ in. size of those days he was still working on his model. I have no knowledge of him building any other model, being a regular reader of M.E. or even visiting a M.E. exhibition. So, why so long on one model? Here written down for the first time are the comments of his fellow student and life-long friend. (Francis Fearnside can't use a file, but has to make special tools or cutters for every little operation and then make fitted boxes to keep them in. It is a tragedy that a man should spend so long on a model engine that is not a model of some particular engine. I have told him to leave it to some college or Institute on the North-east coast where they build marine engines.)

After the builder died in 1944 it was said he had left the model, his tools and other benefits to Bradford Technical College. Seven or eight years ago, at my instigation, the City Museum in the Cartwright Hall borrowed the model for a few months. Thus I was able to see the model again after 25 years or more. It is a sad comment on those concerned, for the model was exhibited with a belt pulley on the end which the builder has used for turning it round by hand.

The workmanship on the model is good, excellent for a person with sight in only one eye, but there are a few points that provoke thought. The size and position of the handles and the steam reversing gear suggest quite a large engine at least 20 ft. high. Such an engine would have a gangway round it. Would such a large engine have only two bolts holding down each main bearing cap?





A SIMPLE BENDING MACHINE

by J. Wardle

AT ONE TIME, I had a requirement to produce several box-shaped chassis from 16 gauge steel and aluminium sheet. Some of these would be used for mounting radio and electronic components, and others (when inverted) for storing various tools.

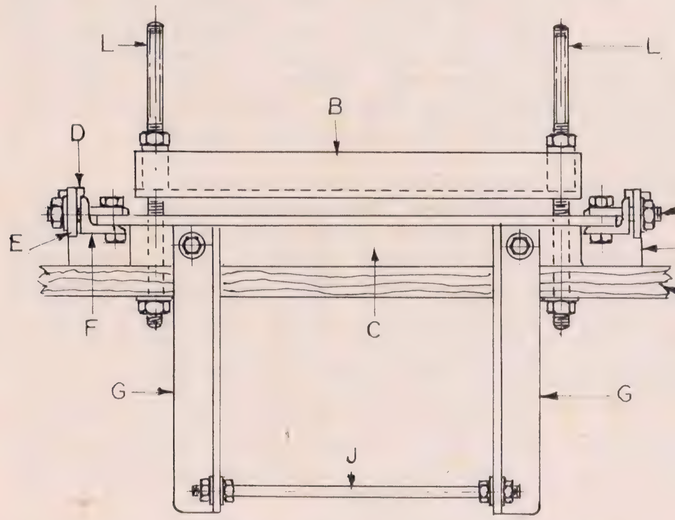
Attempts to produce neat-looking bends in a vice were only partially successful, and in consequence the machine described was constructed. The need for welding, turning, and fitting dowels has been deliberately avoided in this design, but accurate positioning of holes is essential. Although Whitworth screw threads are indicated, these may be changed to BSF, Unified or whatever is most suitable to the constructor.

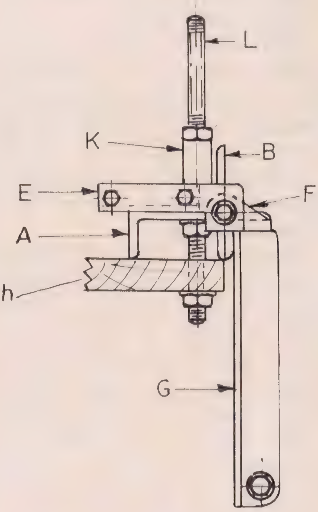
Parts F and C should be made from angle which has "parallel" (i.e. not tapered) flanges, otherwise some fitting will be necessary. In any case the centres of holes Q must on assembly line up with the corner edge of angle C.

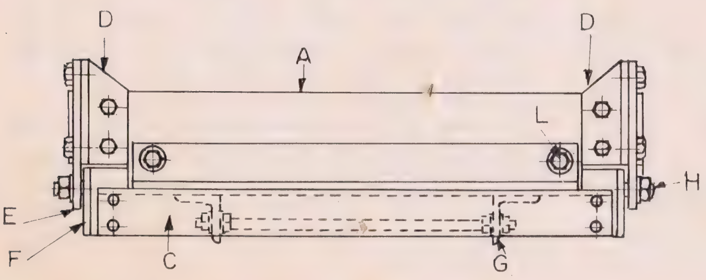
List of materials required—in mild steel:

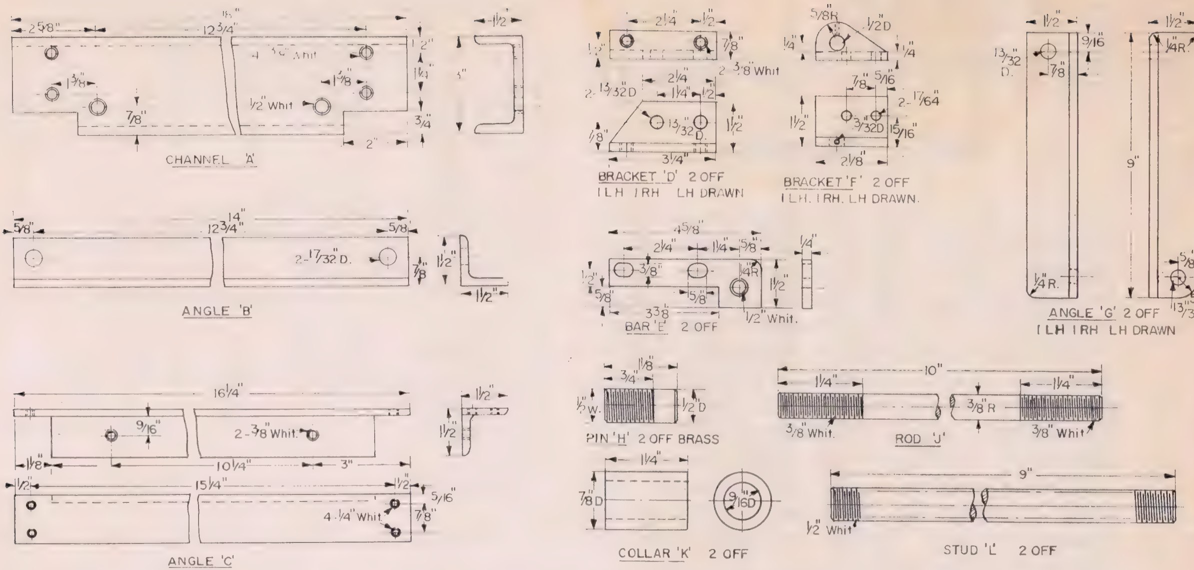
Note: W indicates Whitworth.

L $\frac{1}{2}$ in. W. Studs: 2 pieces 9 in. long.
$\frac{1}{2}$ in. W. Nuts: 6 required (hexagon).
$\frac{1}{2}$ in. Washers: 6 required (two of these for pins H).
$\frac{3}{8}$ in. W. Screws: 10 required (hexagon head) × $\frac{5}{8}$ in. long.
$\frac{3}{8}$ in. Washers: 18 required.
$\frac{3}{8}$ in. W. Nuts: 4 required (hexagon).
J $\frac{3}{8}$ in. dia. Rod: 1 piece 10 in. long screwed $\frac{3}{8}$ in. W. for $1\frac{1}{4}$ in. at each end.
$\frac{1}{4}$ in. W. Screws: 4 required (hexagon head) × $\frac{5}{8}$ in. long.
$\frac{1}{4}$ in. Washers: 4 required.
K Tube $\frac{7}{8}$ in. o.d. × $\frac{9}{16}$ in. i.d. × $1\frac{1}{4}$ in. long: Two pieces required.
A Channel 3 in. × $1\frac{1}{2}$ in. × $\frac{1}{4}$ in.: One piece 18 in. long.
F Angle $1\frac{1}{2}$ in. × $1\frac{1}{2}$ in. × $\frac{1}{4}$ in.: Two pieces $2\frac{1}{8}$ in. long.
D Angle $1\frac{1}{2}$ in. × $1\frac{1}{2}$ in. × $\frac{1}{4}$ in.: Two pieces $3\frac{1}{4}$ in. long.
G Angle $1\frac{1}{2}$ in. × $1\frac{1}{2}$ in. × $\frac{1}{4}$ in.: Two pieces 9 in. long.
B Angle $1\frac{1}{2}$ in. × $1\frac{1}{2}$ in. × $\frac{1}{4}$ in. One piece 14 in. long.
C Angle $1\frac{1}{2}$ in. × $1\frac{1}{2}$ in. × $\frac{1}{4}$ in.: One piece $16\frac{1}{4}$ in. long.









E Bar $1\frac{1}{2}$ in. × $\frac{1}{4}$ in.: Two pieces $4\frac{5}{8}$ in. long (could be cut from spare angle or channel).

Other materials:

H Brass Rod $\frac{1}{2}$ in. dia.: Two pieces $1\frac{1}{8}$ in. long, each screwed $\frac{1}{2}$ in. W. for $\frac{3}{4}$ in. of length.

Building procedure:

Manufacture parts A to L as per drawing. Attach brackets D to bedplate A using four $\frac{3}{8}$ in. dia. × $\frac{5}{8}$ in. long screws and four washers. Attach brackets F to underside of angle C using four $\frac{1}{4}$ in. dia. × $\frac{5}{8}$ in. long screws and four washers.

Assemble rod J and angles G, using four $\frac{3}{8}$ in. nuts and washers. (The distance between angles G should be $8\frac{1}{2}$ in.)

Now secure angles G to angle C with two screws $\frac{3}{8}$ in. dia. × $\frac{5}{8}$ in. long, adding two washers to each screw. Any projection of these screws beyond angle C should be filed off. Screw a brass pin H into a bar E and secure in position with nut and washer, thus forming one "bearing assembly." Repeat for the opposite hand bearing.

Pass $\frac{1}{2}$ in. washers over the brass pins, and fit the two bearing assemblies to brackets F. Using four $\frac{3}{8}$ in. dia. × $\frac{5}{8}$ in. long screws and washers, attach bars E to brackets D. Screw the two $\frac{1}{2}$ in. dia. studs through the channel A so that $3\frac{1}{4}$ in. length projects below, and lock the studs in place using two nuts immediately below the web of the channel.

Drop angle B on to the upper side of the channel, and on each stud add a spacer K, a washer, and nut.

The whole machine is now assembled, and it should be checked that the upper face of angle C lines up with that of channel A. Paint can now be applied to all surfaces except the $\frac{1}{2}$ in. dia. studs which should be lightly greased. After the paint has dried, the bench to which the bender will be attached can be drilled as follows: Drill two holes $\frac{9}{16}$ in. dia. on $12\frac{3}{4}$ in. centres at a distance of $\frac{7}{8}$ in. from the edge of the bench.

To secure the bender to the bench, pass the lower ends of the $\frac{1}{2}$ in. studs vertically through these $\frac{9}{16}$ in. dia. holes and apply a washer and nut to the projecting ends. Tighten up hard to avoid movement of the bender on the bench surface. Apply oil to the $\frac{1}{8}$ in. dia. holes in brackets F.

Examples in the use of the Machine:

(i) To bend 16 gauge strip through a right-angle: Adjust the two screws at each end of the machine so that the space between A and C is $\frac{1}{16}$ in. Lay the strip across the faces of A and C, and tighten down the pressure bar B. Now lift the handle J, turning C through a right-angle—and back again. Release B and withdraw the bent strip.

(ii) To make a box chassis 9 in. × 6 in. with $1\frac{1}{2}$ in. high sides: A bending block just under 6 in. in length will be required, and this can be made from steel channel with a web of say 2 in. or alternatively 2 in. × 2 in. hardwood.

The chassis will first be cut to its "developed" shape and then passed into the bender. Space between A and C is again adjusted to the material thickness. The two longest sides can be bent up in the normal manner.

To bend up the shorter sides raise bar B until both sheet metal and bending block can be accommodated under it. Position the material and block; clamp down bar B and bend up one of the remaining two sides. Using the same method, bend up the opposite side. ▣

CLUB NEWS

News from Towyn

The Talyllyn Railway again had a record season last year, with the passenger journey figure reaching 148,360, an increase of nearly 12 per cent over 1969. No difficult problems were encountered and the peak service of three train operation with four engines in steam was very successful, with excellent voluntary help from members of the Talyllyn Railway Preservation Society. The "Vintage" trains ran on two Saturdays in September with the four original coaches and the original brake van. Both trains were hauled by No. 2 *Dolgoch*, and proved very popular. It is proposed to run similar trains during 1971, when it may be possible to use locomotive No. 2, *Talyllyn*.

Locomotives Nos. 2, 3, 4 and 6 have been in regular service during the past season and all are now receiving general maintenance during the winter months. An additional carriage (No. 20—all third, 48 seats) entered service in July and work on No. 21 is progressing.

Work on re-laying the former mineral extension from Abergynolwyn to Nant Gwernol has been started and volunteer parties are now working under the supervision of the Project Engineer.

Norwich Society

Mr L. J. Taylor gave an interesting talk on December 9, on his model tug, the hull of which, one metre long, was built on a wooden mould, with a brass keel and alternate strips of tinplate with their edges over-lapping. The making of the superstructure was also described and such details as the wheelhouse, the cowl ventilators and the rigging blocks. The power plant, which will incorporate a water-tube boiler, is yet to be made.

With a view to this Society's exhibition next April, members are asked to let the Secretary know how may models they can provide as soon as possible.

Progress at King's Lynn

The King's Lynn & District Society of Model Engineers will be attending three functions in the early part of 1971. These are a display at the Voluntary Organisations Exhibition at the Corn Exchange, King's Lynn, on March 13, the Norwich Society's Exhibition from April 15-17 inclusive and the Walpole St. Andrew Steam Engine Rally on May 1-2.

At the December meeting, 1970, the subject was the restoration of full-size traction engines, Messrs. M. Plumb and F. Howling recounting some of their trials, tribulations and triumphs in this field. Both these enthusiasts have won awards at Rallies for their engines.

The Society has acquired a set of drawings for a 2 in. scale Kitson & Hewitson slanting-shaft ploughing engine.

Secretary: Mr F. Whitehand, 21 Rosebery Avenue, King's Lynn.

News from Johnnesburg

The Rand Society of Model Engineers recently held their (Witwatersrand) small locomotive trials. One of the smallest engines taking part proved the winner, this being René Etter's 0-6-0 tank engine *Twin Sisters*, hauling a load of 540 lb. Second was W. Mitchell's rather similar but slightly larger 0-6-0 tank, while third place was taken by Eric Rowbottom's 5 in. gauge 2-6-0 tank *Kudu*.

Basil Palmer had entered his very interesting new 2-8-0. This engine, which is free-lance, is fitted with poppet valves, Giesel ejector exhaust and many other interesting features, but rather surprisingly, did not do too well against the more conventional engines, coming in 8th place out of nine competitors.

Southampton Society

The first meeting of the Southampton & District Society of Model Engineers took place at the University of Southampton on January 6. The second meeting took place at the Bitterne Park Social Club, and a discussion took place as to which was the better of the two venues for the meetings of the Society. We had not heard the decision at the time these notes were written.

Several new locomotives are being built by members of this society; they include a Great Northern "Single," a 5 in. gauge *Lion*, a 5 in. gauge G.W.R. "Manor," and a *Maisie*.

On October 4 last, the Society paid a visit to the Chingford club, six of their locomotives being put in steam. An afternoon of uninterrupted running took place until 6 p.m.

The Annual Spring Open Day will be held this year on Saturday, April 3, at Riverside Park.

Secretary: R. H. Procter, Tresco, 38 Beechwood Crescent, Chandler's Ford, Hants.

New Society for Swansea. New society recently been formed in Swansea area called "Swansea Society of Model & Experimental Engineers." This society has been formed due to the previously existing society becoming commercialised in the passenger hauling sense. The new society is strictly non-commercial and caters for true model engineering enthusiasts only. New members welcome: contact the Secretary, Mr L. C. Turner, 24 Ashgrove, Killay, Swansea (Tel: 25373). Meetings every fortnight at Y.M.C.A., Swansea.

A Society for Bishop's Stortford? Anyone interested in forming a society in Bishop's Stortford, Herts., please contact Mr K. J. Welch, 11 Robinson Close, Bishop's Stortford.

A Society for Torbay. If any model engineers living in Torbay are interested in forming a club, please contact Mr A. Leeding, 15 Pembroke Road, Foxhole, Paignton, Devon TQ3 3UR. Telephone: 55143.

The Model Engineers' Society (Northern Ireland). Monthly meeting, first Friday of every month. Board Room of the Ashby Institute, Stranmillis Road at 7.45 p.m.

South Durham SME. Future meetings will be held on Tuesday nights from about 7.30 p.m. in Hurworth Grange.

CLUB DIARY

Dates should be sent five weeks before the event. Please state venue and time.

February 19 Romford Model Engineering Club. *NO* meeting at Ardleigh House. Joint meeting with Brentwood Society and Ilford & West Essex Model Railway Club, at Brentwood Venue, 8 p.m.

February 19 Stockport & Dist. SME. Members' films and slide shows. Wellington House, Wellington Road, Heaton Moor. 7.45 p.m.

February 19 Brighton & Hove Society of Miniature Loco. Eng. Model locomotive colour slides. Elm Grove School, Elm Grove, Brighton. 8 p.m.

February 19 *Firefly*—progress meeting. Clubhouse, Old Allotments, Lexden. 7.30 p.m.

February 19 East Sussex Model Engineers. Talk on boiler making by Stanley Garlick. Meeting at Mercatoria. 7.30 p.m.

February 19 Bracknell Railway Society. Bring your favourite railway relics to show to other members. Assistance with transport on request. Pavilion, Jocks Lane Recreation Area, Jocks Lane, Bracknell, Berks. 7.30 p.m.

February 19 Bracknell Railway Society. "4-3-2" Group Meeting at the British Legion Hall, Binfield. 7.30 p.m.

February 19 Rochdale SMEE. General Meeting. Lea Hall, Smith Street, Rochdale. 7.30 p.m.

February 21 City of Leeds SMEE. Working meeting at Templenewsam. 9.30 a.m.

February 22 Wigan & District MES. Meeting at Co-operative Guild Room, Thompson Street, Whelley, Wigan. 7.15 p.m.

February 22 Clyde Shiplovers' & Model Makers' Society. East by North, John Smith. Meeting at the Y.M.C.A. Club, 100 Bothwell Street, Glasgow C.1.

February 23 Sutton Coldfield & North Birmingham MES. To be arranged. Birmingham Co-operative Society's Meeting Room. 286 Brookvale Road, Erdington, Birmingham 23. 8 p.m.

February 24 Birmingham SME. Annual general meeting, at L.M.R. Staff Ass. Club Concert Room.

February 24 Devizes MES. Military Modelling by Major "Sandy" Siburn. The Hare & Hounds, Hare & Hounds Street, Devizes. 7.30 p.m.

February 24 Guildford MES. Tyros' night at H.Q., Stoke Park. 7.45 p.m.

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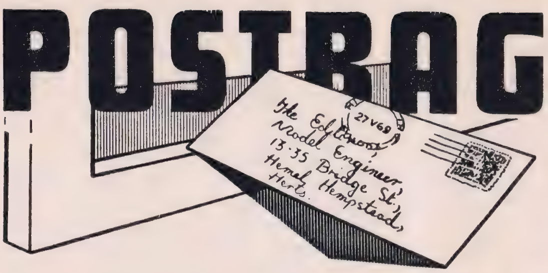


The Editor welcomes letters for these columns. He will give a Book Voucher for thirty shillings for the letter which, in his opinion, is the most interesting published in each issue. Pictures, especially of models, are also welcomed. Letters may be condensed or edited.

Train resistance

SIR,—I well remember the sadly unfinished series of articles in the *Model Railway News* by the late J. N. Maskelyne, called "A new deal for O Gauge" in which he described the late Mr Norris' magnificent railway. I especially remember, even at that gauge, Mr Maskelyne's italics in discussing the running of *steel* wheels on *steel* rails.

Mr Lawrence, in his letter in the January 14 issue, shows a diagram which is the key to the problem, but which can perhaps do with more explanation if only to ensure that those less knowledgeable than Mr Lawrence are not misled.

As the wheel moves forward it is, as Mr Lawrence says, deforming the rail beneath and in front of it. Energy is expended in doing this. As the wheel passes, the rail will reform to its original shape, returning to the wheel the energy it had given to the rail. If the rail is made of a perfectly elastic material, no energy is lost in the process and there is no resistance to rolling. No material is quite perfect in this respect, but steel is much more elastic than most metals otherwise suitable, and hence the least energy will be lost and the least resistance offered by the steel rail. The same considerations apply of course to the wheel. The lost energy turns up either as heat or as strain energy in permanently deforming less elastic materials.

I do not think that the lower adhesion of an alloy rail is a contradiction to its higher resistance to rolling. The adhesion is essentially a matter of the coefficient of friction of the materials forming wheel and rail including any deposits on either and the normal component of reaction. Some alloys, e.g., nickel-silver, are prone to pick up and retain any grease or dirt around and the coefficient of friction is therefore further reduced. Combined with the increased rolling resistance, the lower friction of alloys in service gives rise to more slip. I think that this is quite consistent.

London, N.W.8. C. J. ANTONAKIS, B.Sc.(Eng.), F.I.C.E.

Train resistance, etc.

SIR,—With regard to Mr D. E. Lawrence's interesting comments in "Postbag" (January 1), I feel that a point which needs to be made is that the *rolling resistance* between two surfaces is quite a different matter from the *sliding friction* between them. In the first case, no sliding should occur, only rolling, and *vice versa*.

The rolling resistance of wheels on a railway track is dependent on the hardness of the wheel tyres, and of the rails, and also upon the massiveness or moment of inertia of the rails. For a given load the area of contact between wheel and rail will clearly be less with harder materials than with relatively softer materials. The amount of deformation will therefore be less with the harder materials such as steel and because these are more perfectly elastic than softer materials, less mechanical work is lost in distorting them by the passage of each wheel.

Softer rails may well have a lower coefficient of friction, but these will deflect more under load and the work which is done in distorting them is more completely lost because of their poor elasticity. One does not make springs out of light alloy wire.

One further thought, therefore: rails with poor adhesion are those having a lower coefficient of friction and because they are normally softer will clearly afford a greater resistance to motion.

For example, anti-friction bearings depending upon balls or rollers for their function require very hard materials to exploit the advantages of rolling as opposed to sliding friction. But the races also require adequate support in a housing which will prevent distortion under load.

In full-scale, another source of mechanical resistance is track resistance which is dependent upon the accuracy with which the track is laid, and upon the depth and quality of the ballast beneath the sleepers. The stiffness of the rails, as opposed to the hardness, is also involved, as also are the rail-joints.

Bearing friction is of course a separate issue, unconnected with the type of rail over which the wheels are running. Resistance to motion due to this cause is decided by the coefficient of friction in the bearing divided by the ratio of the diameter of the wheel to that of the bearing. This ratio is usually somewhere about 10 in value.

Those readers who may be interested may like to know that the nature of train resistance was considered in some detail in an article appearing in the "Railway Magazine" for January and February 1968. This article is complementary to that dealing with the running resistance of steam locomotives which was published in M.E. during last summer.

I am also glad to note the comments of Mr D. E. Lawrence and Mr R. A. Smith on I.M.L.E.C., 1970.

Hayes, Kent. J. N. C. LAW (Gp. Capt.).

Petticoat pipes

SIR,—I was pleased to read Mr Taylor's comments on my article (Postbag, November 20). It only goes to bear out the old saying that there is nothing new under the sun. I was careful not to claim the idea as my own, as I have found that no matter what earth-shaking idea you may come up with, somebody, somewhere has thought of it before. I must say, however, that I had not heard of it being applied to a small locomotive, although it is nothing new on the big jobs. It certainly works on the small engines, and while a locomotive may be a good steamer with the usual arrangement, it can become a better one, and it may help to make an indifferent steamer into a good one.

The item on solid hornblocks by Mr J. C. Gibson in the same Postbag, was also interesting. It might interest him to know that the use of wedges is standard practice on the S.A. Railways, and judging by the drawings in the American Locomotive Cyclopaedia for 1941, it was also standard on locomotives in the U.S.A.

Kensington, Johannesburg. D. F. HOLLAND.

Progress?

SIR,—I wish to endorse your comments in "Smoke Rings" January 1 (Progress)—that the current M.E. is better than ever, both in presentation and content. I have been a reader from 1936, and have hundreds of loose copies back to 1900. It is also good value, and improves the image of the hobby considerably.

I feel that it is fortunate to have such able and dedicated people associated with it, one of whom we have alas, recently lost—E. T. Westbury.

It is likely that many readers are not active model engineers, and that many model engineers are not readers, indeed I personally prefer to be guided by reference works from the late 19th century (not so necessary now with the higher technical standards of the improved *Model Engineer*), but to the average enthusiast subscription is a "must." Beginners have many M.A.P. books to cater for their needs, and dilution is unnecessary and undesirable.

In my opinion, you are doing a magnificent job. Best wishes for 1971.

Dudley, Worcs. R. F. WILLETTS.

Metric system

SIR,—Mr Fayers touched a nerve in his comments on the metric system, in Vol. 136, No. 3405.

In reply I would like to say that just because something is old is no reason to believe it is good. Standards based on the length of a finger joint, a man's foot, the length of an ox goad, or the distance from a nose to the end of an outstretched arm are definitely not usable in science. The more our society depends on science the more necessary it is that the basic standards be simple and that their relations, one to another, be simple.

The decimal system of money, to which you are changing, is to the pounds, shillings and pence system as the metric system is to the English system. Think of the many hours of drudgery you went through working mathematics problems on your old style money. Then ask a child how quickly he learned the decimal system.

The metric system works the same way. It is so simple that I guarantee to teach the complete metric system to a normal person in 30 minutes. As an example of the two processes let me propose two problems.

1. An object weighs 3 oz. 15 grains per cubic in. What is its specific gravity, and what does it weigh per cubic yard?

2. Another object weighs 3.23 grams per cubic centimetre. What is its specific gravity and what does it weigh per cubic metre?

Do not use conversion tables, only your memory.

With a college education, I used a slide rule and a pencil to solve the first problem. Mexican miners with a third grade education solve the second problem in their heads.

As for the "well proved" standards, they will not change. Only the ways of measuring them will change. The standards are physical objects but the ways of measuring them are man invented.

I do not think we Americans will adopt the metric system until some world-shaking cataclysm occurs. Our democracy puts a premium on stupidity. Our advances are in spite of, not because of, our measuring system.

The ancients changed their calendar frequently, used any mathematical system they desired, and improved their alphabet as they wished. Yet we, who are supposed to be enlightened, are afraid to vary any one of these items by the slightest jot or tittle.

Ridiculous, isn't it?

San Diego. FRED FRANK.

Cable railway

SIR,—Whilst I agree with Mr Willetts in his letter in *Model Engineer* No. 3408, on the universal popularity of steam locomotives, my earlier letter was written for the interest of readers whose circumstances preclude them from running an engine on a track.

I should imagine that few of the public visiting the M.E. Exhibition who saw the fine examples of stationary engines on display were disposed to query what they were for.

Far from visualising an engine "screwed to a baseboard," I had in mind a powerful and permanent installation, which, with suitable safeguards, could even be passenger carrying. The suggestions of engine house, boiler plant, mill chimney, etc., with the attendant scenic effects, were introduced to create interest.

The design and operation of a cable railway could take various forms. Numbers of your readers during visits to North Devon have probably been interested in the Lynton Cable Railway. The two cars of the railway, with the water tank attached to them, form a counterpoise. Water, from a natural supply, is admitted to the car at the top of the incline whilst water from the car at the bottom is drained off. This operation of the counterpoise results by the variation of weight.

It would not, of course, be permissible to operate a garden railway from a public water supply. A small, steam operated, pumping plant, however, could extract water drained into a pool at the base, and force it into a tank at the summit.

In view of the interest promoted by the articles of Mr E. H. Jeynes, could this gentleman, with his wide knowledge of early engineering schemes, provide readers with one describing cable railways?

Reverting to the letter of Mr Willetts, the Kapp and Manchester dynamos he mentions would be of appropriate type for an early steam generating station. My proposal to utilise a small, low voltage, direct armature —without modification—would dispose of the mysteries and difficulties of rewinding. As Mr Willetts suggests, cast-iron would be suitable for the poles. They, with their coils, should not present difficulties.

Whilst at the time of its publication the M.E. Handbook No. 10 provided a useful service, I do not feel a reprint would be justified. Much more modern and explicit text books should be available at a technical library.

Sidcup, Kent. A. E. MOUNT.

Model thresher

SIR,—I was much interested in the model threshing set by Mr G. W. Cox in M.E. No. 3405, and appreciate his difficulty. I have been experimenting for several years. I have no trouble in threshing Canary seed, Linseed (Flax) or Onion seed. I have also tried white cloves and thresh approximately 95 per cent; run through a second time produces the remaining few seeds. I do not know the type of grass he threshes, but he should be able to get a fair proportion of seed. I have not yet built a complete machine, but have tried the essentials. He does not give the size of the drum.

When I started, I did not build to scale or drawings; I decided to arrange an internal width of machine around 6 in., accordingly I made the concave 5½ in.

inside width. The drum itself was made from three 2¼ in. discs of mild steel, ½ in. wide. These were machined disc flywheel type, leaving the rim ¼ in. thick and the hub ¾ in. dia., drilled for ⅜ in. shaft. Slots were milled 3/16 in. wide, 3/16 in. deep for eight 3/16 in. square beat bars secured by countersunk screws. To lessen the space between these three discs, two alloy rings ½ in. wide were inserted. The beater bars are 5¼ in. long and overlap the end discs by ⅛ in. Slots were formed in the bars by making saw cuts at an angle of approximately 50 per cent, and finishing with a triangular file, the cuts are arranged half-made one way and half the other; this tends to keep the seed heads in the centre. The concave is made with 3/32 in. end plates and has ten ⅛ in. square bars and two 3/16 in. square bars, secured with nuts; 29 wires, 15 s.w.g., spaced 3/16 in. centres are also used. The bars are spaced ½ in. centres on 1⅝ in. radius except two at each end, which are splayed outwards slightly.

With regard to the dresser, I have tried all sizes of holes and slopes, and find 5/32 in. holes for the cavings riddle with 9/64 in. for the chaff riddle gives the best results. I would suggest to Mr Cox that he makes his holes not less than two-thirds the length of his grass seed, remembering half of the seed will balance over a hole before falling through, also the air will lift the seed over. I too have had trouble with white clover tending to bunch on the cavings riddle and partly overcame this by inserting two deflectors ⅝ in. deep underneath (distance apart found by trial) to increase the air flow at the front end of the sieve; this helps in preventing build-up. As regards the speed of the drum, I used an electric motor, speed 1,425 r.p.m., with equal size of pulleys, and found some seed heads were carried over by the beater bars; fitting a larger pulley on the drum and reducing the speed to about 1,200 r.p.m. gave more satisfactory results. The building of a machine to do actual work entails much more work than building a scale model which just revolves.

I wish Mr Cox luck, and would suggest to him, and others, that when building a machine for work to make his drum as heavy as possible with concave to suit.

Attleborough, Norfolk. G. W. TAYLOR.

Toolholder design

SIR,—The quick-change toolholder, December 4 and 18, is another of those excellent attachments which we have come to expect from Mr J. A. Radford.

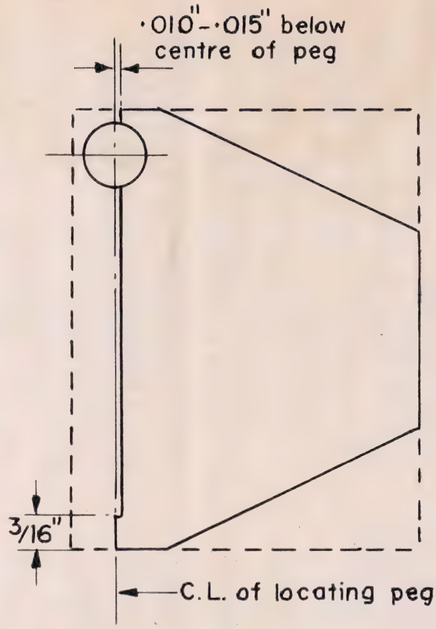
It would be most useful to any amateur model engineer who wants to turn out as much work as possible in a limited time. The time taken to make it in the first instance would be well repaid.

It is a pity however that Mr Radford has fallen for that *Ignis Fatuus* that has lured so many machine designers.

I refer to the method of locating two machine elements whether they be fixed or moving on to two round rods.

This has been done many times in slide rests, machine vices, hacksaw machines, lathe beds, etc., usually on the score of cheapness, although some of the lathes which have embodied this principle have been far from cheap. These applications all have the drawback that it is almost impossible to ensure that contact is equal on both rods.

It might be possible with extreme care and with suitable equipment such as Mr Radford has to achieve passable results. In the hands of many amateurs however the end product would leave much to be desired. The disadvantages in the design of this fixture could



be overcome simply and in the process the extreme accuracy needed in fitting the two locating pegs would be avoided.

I would suggest that one of the locating pegs be dispensed with and replaced by a flat surface as on my sketch. The mounting block should be made the same size as described and drilled by means of the jig but omitting one of the U holes. Only one locating peg need then be fitted as described on page 1230.

After this the block is milled off .250 in. on the mounting face and further milled off .010 in./.015 in. below the peg centre leaving a land 3/16 in. wide at the end opposite the locating peg. The two U holes may be drilled in the toolholders which may then be fitted either way round.

This modification will ensure that the toolholders are firmly in contact with the locating peg and held rigid by clamping on to the flat land.

Incidentally, I notice that the Tee slot has been omitted in the drawing of the Type C swivelling toolholder.

Letchworth. A. E. BOWYER-LOWE.

Stiffness of steel

SIR,—I cannot agree with Mr Rimmer's note on this subject. " Strength of Materials " by Morley gives the following for a shaft in Torsion:

$$\theta = \frac{538\ TL}{ND^4}\ \text{degrees}$$

θ is the angle of twist in a shaft of length L and diameter D, and N is the modulus of shear. For steel, this is about 2/5 Young's modulus E. My only reference book to hand at the moment gives E for mild steel as 30×10^6, and for Tool Steel (specification not quoted) as 40×10^6 expressed in pounds-inch units. Therefore, the use of tool steel reduces the amount of deflection by a factor of ¾. I do not see how this can be regarded other than as an increase in rigidity.

Kemerton, Nr. Tewkesbury. K. E. G. ANDREWS, M.Sc.

Old type dynamos

SIR,—In his letter to Postbag, January 1, 1971, regarding Cable Railways, Mr R. F. Willetts laments the lack of information about the design of old type dynamos and suggests the reprinting of the famous M.E. handbook No. 10 " Small Dynamos and Motors." Although such a reprint would be of considerable interest it must be remembered that the open slot pattern armature laminations used in those early days are no longer available from present day manufacturers and some modifications would be inevitable. However, the modern semi-closed pattern slots common in the industrial field today can be used with suitably revised windings and I for one would be only too pleased to do the necessary calculations if the demand justified it.

I would not advise the use of cast-iron for the field magnets and poles as mentioned in the first of Mr Willetts' three hints. Depending on its quality (and this can vary quite a lot) cast-iron requires for a given value of magnetic flux density appreciably more exciting ampere turns than mild steel and with the latter one can fabricate easily and so avoid the making of patterns for castings.

The old M.E. handbooks were very useful guides for the amateur, but that cannot be said for everything in Avery's book " The A.B.C. of Dynamo Design," which contains a multitude of errors and it should be treated with great caution.

Warminster. F. L. DAVIES.

Showman's engine

SIR,—Can anyone living in the Wadebridge, Cornwall, area help me? The reason I ask is that I require certain detailed information on Fowler showman's engine—*Kitchener* (Iron Maiden). I am informed that she is in the Vintage Museum at Wadebridge—but have had no reply to my enquiries from that source.

Although any and all photographs would be appreciated, the information I specifically require is as follows:

1. How are the 2nd and final shaft bearings lubricated?
2. Details of oil box flaps.
3. Details of oil trays (if fitted) underneath the motion.
4. Details of working platform at the side of the motion.

If any M.E. reader with access to this engine could get me some photographs, I would be happy to come to an arrangement to compensate him as regards expenses.

Whilst in print—I would like to ask the following question: Does anyone know the early history of No. 15657—*Kitchener*? When was she built? Was she a conversion?

61 Corporation Avenue, J. L. BURD.
Llanelli, South Wales.

3½ in. gauge locomotive " ROB ROY "

It is hoped shortly to publish a book on the building of the popular M.E. design *Rob Roy*. The Editor would much appreciate the loan of photographs of any models to this design that have been made by readers. Pictures showing models or parts thereof under construction would be particularly welcome. All pictures published would be paid for.

Mechanical Lubricator

Continued from page 195

end and solder-sweated into place. It should project slightly, such projection being removed while turning the disc to its final diameter.

The two cylinder covers are similar to the front end cover of a locomotive cylinder, except that a $\frac{15}{32}$ in. wide flat is made on each to clear the pump mounting piece. The spigot on each cover is $\frac{9}{16}$ in. dia. and projects $\frac{1}{32}$ in. To adjust the side clearance of the disc, it is only necessary to rub either the spigot-side of the covers or the disc on a sheet of fine emery cloth on a surface plate until a fit just short of binding when the four bolts are tightened is obtained.

The inner cover is secured to the $\frac{1}{4}$ in. × $\frac{1}{8}$ in. backing plate which incorporates the crankshaft bearing at its upper end, by a central countersunk head $\frac{1}{8}$ in. × 40 t.p.i. screw, and is prevented from turning by a dowel as shown.

The fixed ports are drilled through the No. 50 hole forming the moving port, when the disc is at the limit of its oscillation in either direction. It is important to push the disc out sideways after each drilling in order to remove any possibility of scoring the " land " between the fixed ports, as might occur if the disc were rotated from one port position to the other during the port-drilling operation. A touch with a No. 40 drill twisted between the fingers may be used to remove any burr at the entrance to the fixed ports.

The pump base, or outlet fitting, which is solder-sweated into position, houses a $\frac{1}{8}$ in. ball non-return valve (not shown). The outside is screwed $\frac{5}{16}$ in. × 40 t.p.i. to take a nut which holds the pump down onto the floor of the oil-tank. The ratchet drive to the pump is not shown as this follows standard LBSC design. ■

SHAND MASON FIRE ENGINE DRAWINGS

Ref. M28

Sheet 1—General arrangement, chassis, springs, fore-carriage frame.

Sheet 2—Superstructure, chassis fittings, brake gear.

Sheet 3—Cylinder block, general arrangement and details of steam pump.

Sheet 4—Further steam pump details, bunker, feed tank and grate.

Sheet 5—General arrangement and details of boiler, grate, boiler fittings, road wheels.

Sheet 6—Details of the cylinders and pump blocks.

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CLUB DIARY

Continued from page 199

February 24 Swansea SMEE. Meeting at Y.M.C.A., Swansea. 7.30 p.m.

February 24 Harrow & Wembley SME. Locomotive Section meeting, including visit from Ickenham SME, B.R.S.A. Pavilion, Headstone Lane. 7.45 p.m.

February 25 Harlington Locomotive Society. Mr Phil Kelly with his remarkable slides.

February 26 Bracknell Railway Society. 8 mm. cine show by David Howard on a variety of transport subjects. Pavilion, Jocks Lane, Recreation Area, Jocks Lane, Bracknell, Berks. 7.30 p.m.

February 26/27/28 The Association of Model Railway Societies in Scotland. Scotland's National Model Railway Show, McLellan Galleries, Sauchiehall Street, Glasgow. Admission: Adults 3/-, Children 1/6d., Family 7/6d. For school and party rates contact the secretary. At least 16 working layouts also large scale trams. For further details contact: Tony Sparks, Secretary, 39 Park Road, Glasgow C.4.

February 28 City of Leeds SMEE. Working meeting at Templenewsam. 9.30 a.m.

March Huddersfield SME. Annual general meeting. Highfields H.Q. 7.30 p.m.

March 1 Fareham & District MES. Bring and buy sale. Fareham Community Centre. 8 p.m.

March 2 City of Leeds SMEE. Talk by Mr E. Haswell on his new locomotive, with hints and tips. At Salem Chapel. 7.30 p.m.

March 2 South Cheshire Live Steam Society. Pattern making for model locomotives. Shavington Social Club, Shavington, Crewe, Cheshire. 7.45 p.m.

March 4 Hull Society of Model Engineers. Discussion night at the Trades and Labour Club, Room 3, Beverley Road, Hull at 7.45 p.m.

March 4 Harlington Locomotive Society. The Auxilliary and National Fire Service Preservation Group describe the aims and interests of their group.

March 4 Huddersfield SME. Mill Engines, A. Brook. At Highfields H.Q. 7.30 p.m.

March 5 Romford Model Engineering Club. Competition night. Ardleigh House, Ardleigh Green Road, Hornchurch. 8 p.m.

March 5 Brighton & Hove Society of Miniature Loco. Eng. Film show by Frank Greeves. Elm Grove School, Elm Grove, Brighton. 8 p.m.

March 5 East Sussex Model Engineers. Workshop practice. The job that went wrong. Mercatoria. 7.30 p.m.

March 5 Colchester SMEE. Traction engines, illustrated lecture by Rev. Stebbing. Clubhouse, Old Allotments, Lexden. 7.30 p.m.

March 5 Stockport SME. "Bits and Pieces." Wellington House, Wellington Road, Heaton Moor. 7.45 p.m.

March 6 The Society of Model & Experimental Engineers. Talk on s.s. *Great Britain*, by Dr E. C. B. Corlett.

March 7 Colchester SMEE. Working Party. Clubhouse, Old Allotments, Lexden. 10 a.m.

March 7 City of Leeds SMEE. Working meeting at Temple newsam. 9.30 a.m.

March 8 Clyde Shiplovers' & Model Makers' Society. Some Clydeside Memories, Dan MacDonald. Meeting at Kelvingrove Museum and Art Galleries.

March 8 North Wales MES. Meeting at Penrhyn New Hall, Penrhyn Bay, Llandudno at 7.30 p.m.

March 9 Sutton Coldfield & North Birmingham MES. Auction at the Birmingham Co-operative Society's Meeting Room, 286 Brookvale Road, Erdington, Birmingham 23. 8 p.m.

March 10 Harrow & Wembley SME. Transparency competition for the Jeffries Cup. B.R.S.A. Pavilion, Headstone Lane. 7.45 p.m.

March 10 Birmingham SME. Annual general meeting.

March 13 Bedford MES. Exhibition of models at Civic Theatre, Horne Lane, (Nr. St. Pauls Church), Bedford. 11 a.m. to 9 p.m. Locomotives, railway layout, traction engines, boats, aircraft, woodwork, radio control, beam engines, pistols, tools, etc.

March 14 City of Leeds SMEE. Working meeting at Templenewsam. 9 30 a m.

March 16 City of Leeds SMEE. Review of rules of the Society, Salem Chapel. 7.30 p.m.

March 16 South Cheshire Live Steam Society. "Bits and Pieces." Shaving Social Club, Shavington, Crewe, Cheshire. 8 p.m.

March 16 Crewe Model Engineering Society. Building a "Britannia" for 5 in. gauge, by J. Kent. To be held at Queens Park Hotel, Wistastion Road, Crewe at 7.30 p.m.

March 16 Chesterfield & District MES. Bryan Donkin Canteen at 7.30 p.m. Annual Meeting and Exhibition of Members Work.

March 17 Bracknell Railway Society. Motive power section committee meeting at 1 Dashwood Close, Bracknell, commencing 8 p.m.

March 17 Southampton & District SME. Annual general meeting. 7.30 p.m.

March 17/18 Museum of Science and Industry. Film show—R & M THE Bearing People. Newhall Street, Birmingham 3. 1.15 p.m.

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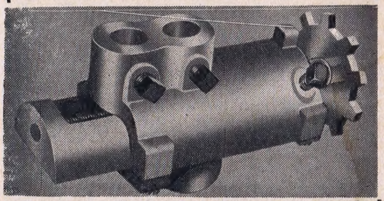

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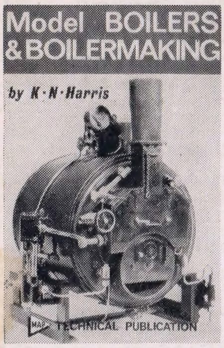

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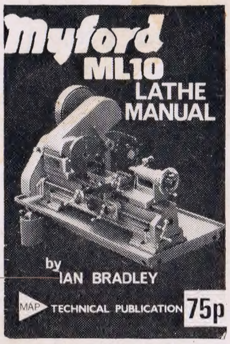

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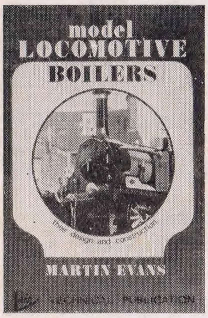

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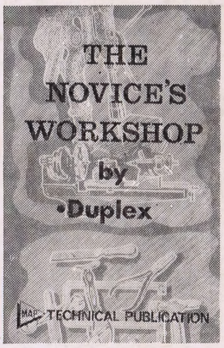

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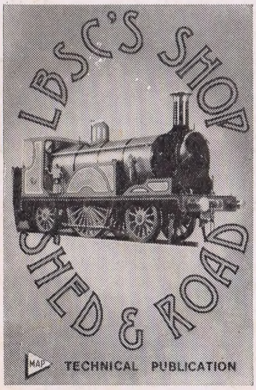

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